Optergy API Documentation

(P864)

Rev 1.0

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1. P864 REST API (IoT Application)

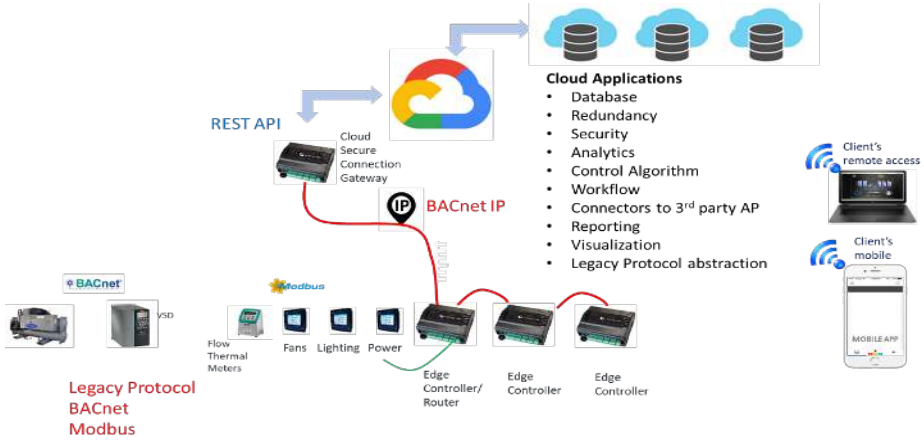
A RESTful web application exposes information about itself in the form of information about its resources. It also enables the client to take actions on those resources, such as create new resources (i.e. create a new user) or change existing resources (i.e. edit user settings).

In order for your APIs to be RESTful, you have to follow a set of constraints when you write them. The REST set of constraints will make your APIs easier to use and also easier to discover, meaning a developer who is just starting to use your APIs will have an easier time learning how to do so.

REST stands for **RE**presentational **S**tate **T**ransfer.

It means when a RESTful API is called, the server will transfer to the client a representation of the state of the requested resource.

For more information about REST interface click here:

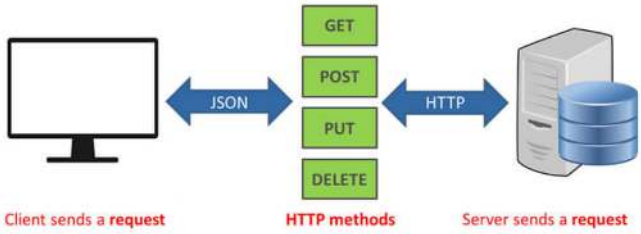


In addition to supporting Legacy Protocols such as BACnet and Modbus, the P864 supports a REST interface that allows developers to create IoT applications using JSON format. This opens up a number of integration options for devices that don't support BACnet or Modbus. IoT brings many new devices that may be cloud based, or have their own interface that is more amenable to a JSON format interface.

This Optergy API secures the communication to the internetwork using JWT. This creates a secure session that expires after a prescribed period, and cannot be exploited by others. This layer of security is also transparent to existing infrastructure and passes as HTTP/HTTPS traffic meaning no special router configuration is needed or ports opened. This results in a more secure access to a device, much more so than open protocols like Modbus or BACnet.

This document is intended to be used by technical users that have an understanding of JSON (Java Script Object Notation). The information below will help you create 3rd party applications that can read and write to a P864.

1.1. What the API Does



Think of the API as an interface that operates like a transaction. A CLIENT secure connection is created (Javascript Web Token or JWT), an API Client request using GET, POST, PUT, and DELETE, and the server authorizes connection and returns or executes the Client request.

GET= Read a value and return it to the Client

POST= Create a value or values in the server and confirm result

PUT= Update/Replace a value or values in the server and confirm result

DELETE= Delete an object or value from the server

ENDPOINTS= destination for Get/Post/Put/Del commands e.g. https://192.168.1.1/version

1.2. P864 Objects the User can interact with using the API

(P864 v 5.6.8)

1. Manage API Authentication (JWT)
2. Manage 864 device configuration
3. Manage system time
4. Manage users (add/edit/delete)
5. Manage BACnet objects (add/edit/delete)
    a. Analog inputs, outputs and values
    b. Binary inputs, outputs and values

Future Support

1. Schedule and event times
2. Trendlog setup
3. Alarms (Event Enrolments)
4. Notification Classes
5. Manage programming tool
6. Diagnostic logs

2. Introduction

The P864 API lets you manage the P864 controller over HTTPS, allowing the controller to integrate with other HTTPS/ IoT devices. Depending on your role permissions, the API allows you to do tasks such as the following:

- Manage 864 device configuration
- Manage users
- Manage BACnet objects

For testing purposes, we recommend Postman an application that allows user to send commands to devices. The software can be downloaded here:

https://www.getpostman.com/downloads/

3. Overview

This document describes the HTTPS endpoints that are accessible to invoke the API. These endpoints conform as much as possible to REST architecture, with the exception of extra endpoints where needed and where analogs and binaries interchange ID for INSTANCE.

Note that the 864 can only host local BACnet objects and hence the host device properties for these endpoints default to local.

The majority of requests are restricted based on user roles.

3.1. User Roles

Admin = 0,
Technician = 1,
IT User = 2,
Air Balancer = 3

The rest of the enumerations are in the glossary at the end of this document.

4. Presentation

The resource format will be presented first, then the requests presented will be expressed in this format:

Request Method	POST, GET, PUT or DELETE
URL	/api/...
Body (required)	
Body (optional)	
Response	
Accessible By	UserRoles

All requests are expected to be in JSON format and the response will also be formatted in JSON.

Example of a given response JSON object:

```
{  "id" : "1234".
  "description": "some description"
  .... values
}
```

If the request results in an error, the response will a JSON object with the following properties:

- `statusCode` - the HTTP status code
- `error` - the HTTP status message (e.g. 'Bad Request', 'Internal Server Error')
- `message` - the error message

Example error response:

```
{
   "statusCode": 401,
   "error": "Unauthorized",
   "message": "Unauthorized."
}
```

5. API Authentication

The API uses JWT (JSON Web Tokens) to control authentication and authorization the API.

Each HTTP request must contain a valid JWT to authenticate the request. The token must be provided on the “Authorization” header of the request in the format “Bearer <token>”, where <token> is a placeholder for your token e.g. “**Authorization”: “Bearer eyJ…...Vr3u4** “

A JWT is valid for a given period of time and will eventually expire. Once the token expires, a new token will need to be obtained and provided with subsequent requests.

The below endpoint defines how to obtain a valid JWT that will then need to be sent with each subsequent request.

Request Method	POST
URL	/authorize
Body (required)	username password
Response	token: valid JWT
Accessible By	Open to all

Request:

POST https://192.168.1.1/authorize

Body:

```
{
	"username": "admin",
	"password": "password"
}
```

Response:

```
{
"token": "ey……..…alphanumeric text……5c"
}
```

6. Version

Version of the API module.

Request Method	GET
URL	/version
Response	version number
Accessible By	Open to all

Example:

Request:
GET https://192.168.1.1/version

Response:

```
{   "version": "1.1.7"
}
```

7. Device Object

The 864 device's properties are:

- id: not used - reserved
- mstpNetworkNumber: number
  - Between 1 and 65534 (inclusive)
- ipNetworkNumber: number
  - Between 1 and 65534 (inclusive)
- ipAddress: string
  - Must be a valid IPV4 address
  - Must be a valid combination with the subnetMask and defaultGW
- subnetMask: string
  - Any contiguous mask and cannot be '255.255.255.255'
- defaultGW: string
  - Must be a valid IPV4 address
  - Must be a valid combination with the subnetMask and ipAddress
- baud: number
  - Can be 4800, 9600, 19200, 38400, 57600, 76800 or 115200
  - Note: Setting Baud rate to 4800 will enable autoBaudrate
- deviceLocation: string
- description: string
- deviceInstance: number
  - Between 1 and 4194303 (inclusive)
- units: string ("Metric" or "Imperial")
- mstpMacAddress: string
- bacnetMode: string
  - Can be 'Router', 'IP', 'MSTP' or 'Segregated
- ethernetMode: string
  - Can be 'STATIC', 'DHCP' or '192.168.1.MAC'
- auxComMode: number
  - AuxComOptions
- bacnetIpPort: number
- modbusIpPort: number
- com2NetworkNumber: number
  - Between 1 and 655354 (inclusive)
- com2BaudRate: number
  - Can be 4800, 9600, 19200, 38400, 57600, 76800 or 115200
- autoInstance: boolean

Request Method	GET
URL	/api/device/config
Response	device object
Accessible By	0, 1, 2, 3

Request:
GET https://192.168.1.1/

Response:

```
{
    "baud": "auto",
    "modbusIpPort": 502,
    "bacnetIpPort": 47808,
    "defaultGW": "192.168.1.1",
    "mstpMacAddress": 1,
    "com2BaudRate": 76800,
    "ipNetworkNumber": 1,
    "ipAddress": "192.168.1.1",
    "description": "",
    "units": "Imperial",
    "subnetMask": "255.255.255.0",
    "deviceInstance": 864001,
    "bacnetMode": "Segregated",
    "mstpNetworkNumber": 99,
    "auxComMode": 0,
    "com2NetworkNumber": 500,
    "id": 69,
    "ethernetMode": "192.168.1.MAC",
    "autoInstance": true,
    "softwareVersion": "5.6.9c",
    "deviceLocation": ""
}
```


Obtains the configuration that relates to the 864 device in terms of system, IP and MSTP.

Request Method	PUT
URL	/api/device/config
Body (required)	deviceInstance bacnetMode ethernetMode subnetMask ipAddress defaultGW baud
Body (optional)	Refer to other properties
Response	device object
Accessible By	0, 1, 2, 3

Update the configuration that relates to the 864 device of system, IP and MSTP.

Request:
PUT: https://192.168.1.2/api/device/config

Body:

```
{
    "baud": "auto",
    "modbusIpPort": 502,
    "bacnetIpPort": 47808,
    "defaultGW": "192.168.1.1",
    "mstpMacAddress": 1,
    "com2BaudRate": 76800,
    "ipNetworkNumber": 1,
    "ipAddress": "192.168.1.1",
    "description": "DESCRIPTION VIA API",
    "units": "Imperial",
    "subnetMask": "255.255.255.0",
    "deviceInstance": 864001,
    "bacnetMode": "Segregated",
    "mstpNetworkNumber": 99,
    "auxComMode": 0,
    "com2NetworkNumber": 500,
    "id": 69,
    "ethernetMode": "192.168.1.MAC",
    "autoInstance": true,
    "softwareVersion": "5.6.9c",
    "deviceLocation": ""
}
```


Response:


```
{
    "baud": "auto",
    "modbusIpPort": 502,
    "bacnetIpPort": 47808,
    "defaultGW": "192.168.1.1",
    "mstpMacAddress": 1,
    "com2BaudRate": 76800,
    "ipNetworkNumber": 1,
    "ipAddress": "192.168.1.1",
    "description": "DESCRIPTION VIA API",
    "units": "Imperial",
    "subnetMask": "255.255.255.0",
    "deviceInstance": 864001,
    "bacnetMode": "Segregated",
    "mstpNetworkNumber": 99,
    "auxComMode": 0,
    "com2NetworkNumber": 500,
    "id": 69,
    "ethernetMode": "192.168.1.MAC",
    "autoInstance": true,
    "softwareVersion": "5.6.9c",
    "deviceLocation": ""
}
```


Request Method	GET
URL	/api/device/system-time
Response	dateTime : ISO String with TimeZone offset
Accessible By	0, 1, 2, 3

Gets the system-time of the device.

Request:
GET https://192.168.1.1/api/device/system-time

Response:

```
{
   "dateTime": "2020-03-06T09:02:49+00:00"
}
```


Request Method	PUT
URL	/api/device/system-time
Body (required)	dateTime : YY.MM.DD-HH:MM
Response	token: valid JWT
Accessible By	0

Updates the system-time of the device.

Note: Changing the system time may invalidate the current JWT, a new valid JWT is returned from a successful update.

Request:
PUT https://192.168.1.1/api/device/system-time

Body:

```
{ "dateTime": "2020-03-06T09:05:49+00:00"}
```

8. Users

The 864 user's properties consists of:

- id: number
- username: string
- firstName: string
- lastName: string
- emailAddress: string
- hashedPassword: string
- Organisation: string
- role: UserRoles
- darkMode: Boolean
- passwordResetRequired: Boolean
    - default true
- firstLogin: boolean
    - default true

Request Method	GET
URL	/api/users
Response	A collection of all users
Accessible By	0

Gets all users.

Request:
GET https://192.168.1.1/api/users

Response: [

```
{
   "lastName": "admin",
   "lastLogin": null,
   "role": 0,
   "firstLogin": false,
   "organisation": "",
   "failedLoginAttempts": 0,
   "firstName": "admin",
   "emailAddress": "temporary@email.com",
   "id": 1,
   "darkMode": false,
   "hashedpassword": "abcd",
   "passwordResetRequired": false,
   "username": "admin"
}]
```

Request Method	GET
URL	/api/users/:id
Response	User
Accessible By	The authenticated user

Get a single user.

Request:
GET https://192.168.1.1/api/users/1

Response:

```
{
   "lastName": "admin",
   "lastLogin": null,
    "role": 0,
   "firstLogin": false,
   "organisation": "",
   "failedLoginAttempts": 0,
   "firstName": "admin",
   "emailAddress": "temporary@email.com",
   "id": 1,
   "darkMode": false,
   "hashedpassword": "abcd",
   "passwordResetRequired": false,
   "username": "admin"
}
```


Request Method	POST
URL	/api/users/register
Body (required)	username firstName lastName emailAddress organisation newPassword newPasswordCheck role
Body (optional)	refer to other properties
Response	User
Accessible By	0

Create/Update a user

Request:
POST: https://192.168.1.1/api/users/register

Body:
{"username":"TestUsername","firstName":"name","lastName":"last","emailAddress":"temporary@email.com","organisation":"","newPassword":"Password!23","newPasswordCheck":"Password!23","role":0}

Response:
{
"lastName": "lastName",
"lastLogin": null,
"role": 0,
"firstLogin": false,
"organisation": "",
"failedLoginAttempts": 0,
"firstName": "name",
"emailAddress": "temporary@email.com",
"hashedpassword": "abcd",
"darkMode": false,
"id": 2,
"passwordResetRequired": false,
"username": "TestUsername
}

Request Method	DELETE
URL	/api/users/:id
Response	User
Accessible By	0

Deletes a user by id. Note that you cannot delete yourself.

Request:
DELETE: https://192.168.1.1/api/users/2

9. Analog Objects (Inputs/Outputs/Values)

The 864 analog properties consists of:

- instance: number
  - used as the primary key id
- objectName: number
  - not writeable
- objectType: number
  - not writeable
- presentValue: number
- description: string
- eventState: BACnetEventState
- outOfService: boolean
- units: BACnetEngineeringUnits
- priorityArray: number[16]
  - only for analog values and analog outputs
- relinquishDefault: number
  - Only for analog values and analog outputs
- mode: string
  - only for analog input
  - string consists of mode, min, max and pulse weight separated by “-”
    - AIMode-min-max-pulseWeight
  - min, max, pulseWeight is optional depending on the mode

Request Method	GET
URL	/api/ai /api/av /api/ao
Response	Collection of AI/AV/AO
Accessible By	0, 1, 3

Gets all analogs.

Request:
GET https://192.168.1.1/api/ai/

Response:

```
[
   {
      "mode": "4|10|83",
      "presentValue": "24.0",
      "instance": 7,
      "eventState": "normal",
      "outOfService": false,
```

```
    "description": "Pulse",
    "objectName": "Analog Input 7",
    "units": 83,
    "objectType": 0,
    "relinquishDefault": "Null",
    "success": true
},
{
    "mode": "6|95",
    "presentValue": "65534.0",
    "instance": 8,
    "eventState": "normal",
    "outOfService": false,
    "description": "",
    "objectName": "Analog Input 8",
    "units": 95,
    "objectType": 0,
    "relinquishDefault": "Null",
    "success": true
},
{
    "mode": "1|0|100|77",
    "presentValue": "0.0",
    "instance": 5,
    "eventState": "normal",
    "outOfService": false,
    "description": "0-10 Volts",
    "objectName": "Analog Input 5",
    "units": 77,
    "objectType": 0,
    "relinquishDefault": "Null",
    "success": true
},
{
    "mode": "1|0|100|77",
    "presentValue": "0.0",
    "instance": 6,
    "eventState": "normal",
    "outOfService": false,
    "description": "0-10 Volts",
    "objectName": "Analog Input 6",
    "units": 77,
    "objectType": 0,
    "relinquishDefault": "Null",
    "success": true
},
{
    "mode": "3|0|100|47",
    "presentValue": "-25.0",
    "instance": 3,
    "eventState": "normal",
    "outOfService": false,
    "description": "4-20 mA",
    "objectName": "Analog Input 3",
    "units": 47,
    "objectType": 0,
    "relinquishDefault": "Null",
```

```
    "success": true
  },
  {
    "mode": "6|95",
    "presentValue": "65534.0",
    "instance": 4,
    "eventState": "normal",
    "outOfService": false,
    "description": "",
    "objectName": "Analog Input 4",
    "units": 95,
    "objectType": 0,
    "relinquishDefault": "Null",
    "success": true
  },
  {
    "mode": "2|64",
    "presentValue": "68.08881",
    "instance": 1,
    "eventState": "normal",
    "outOfService": false,
    "description": "10K Thermistor",
    "objectName": "Analog Input 1",
    "units": 64,
    "objectType": 0,
    "relinquishDefault": "Null",
    "success": true
  },
  {
    "mode": "3|0|100|47",
    "presentValue": "-25.0",
    "instance": 2,
    "eventState": "normal",
    "outOfService": false,
    "description": "4-20 mA",
    "objectName": "Analog Input 2",
    "units": 47,
    "objectType": 0,
    "relinquishDefault": "Null",
    "success": true
  }
]
```


Request Method	GET
URL	/api/ai/:instance /api/av/:instance /api/ao/:instance
Response	AI/AV/AO with the respective instance
Accessible By	0, 1, 3

Gets analog by instance number

Request:
GET https://192.168.1.1/api/ai/1

Response:

```
{
    "mode": "2|64",
    "presentValue": "68.044266",
    "instance": 1,
    "eventState": "normal",
    "outOfService": false,
    "description": "10K Thermistor",
    "objectName": "Analog Input 1",
    "units": 64,
    "objectType": 0,
    "relinquishDefault": "Null"
}
```


Request Method	POST
URL	/api/av/:instance /api/ao/:instance /api/ai/:instance
Body (required)	property: <refer to properties> value: string arrayIndex: number
Response	AI/AV/AO with the respective instance
Accessible By	0, 1, 3

Writes a single property to an analog value or analog output.

Optional body is only applicable to analog outputs.

Request:
POST https://192.168.1.2/api/ao/1

Body:

```
{"value":"80","arrayIndex":8,"property":"presentValue"}
```


Response:

```
{
    "mode": "1",
    "presentValue": "80.0",
    "instance": 1,
    "eventState": "normal",
    "outOfService": false,
    "description": "AO 1 @ 50%",
    "objectName": "Analog Output 1",
    "priorityArray": [
```

```
        null,
        null,
        null,
        null,
        null,
        null,
        null,
        "80.0",
        null,
        null,
        null,
        null,
        null,
        null,
        null,
        null
    ],
    "units": 95,
    "objectType": "analogOutput",
    "relinquishDefault": "0.0"
}
```


Request Method	POST
URL	/api/ai/:instance/mode
Body (required)	mode “ -
Response	AI
Accessible By	0, 1, 3

Writes mode to analog input. Refer to how the mode string is expressed in AI properties above…

Request:
POST https://192.168.1.2/api/ai/1/mode

Body:

```
{"mode": "2"}
```


Response:

```
{
"mode": "2",
"instance": 1,
"objectType": 0
}
```

10. Binary Objects

The 864 binary objects properties consists of:

- instance: number
    - used as the primary key id
- objectName: number
    - not writeable
- objectType: number
    - not writeable
- presentValue: any
    - must be 0 or 1
    - or “inactive” or “active”
- description: string
- eventState: BACnetEventState
- outOfService: boolean
- units: BACnetEngineeringUnits
- priorityArray: any[16]
    - only for binary values and binary outputs
- relinquishDefault: number
    - only for binary values and binary outputs

Request Method	GET
URL	/api/bi /api/bv /api/bo
Response	Collection of BIs/BVs/BOs
Accessible By	0, 1, 3

Gets all binaries.

Request:
GET https://192.168.1.1/api/bo/

Response:


```
[
    {
        "presentValue": "Inactive",
        "instance": 6,
        "eventState": "normal",
        "outOfService": false,
        "description": "",
        "objectName": "Binary Output 6",
        "priorityArray": [
            null,
            null,
            null,
            null,
```

```
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null
        ],
        "objectType": 4,
        "relinquishDefault": "Inactive",
        "success": true
    },
    {
        "presentValue": "Inactive",
        "instance": 5,
        "eventState": "normal",
        "outOfService": false,
        "description": "",
        "objectName": "Binary Output 5",
        "priorityArray": [
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null
        ],
        "objectType": 4,
        "relinquishDefault": "Inactive",
        "success": true
    },
    {
        "presentValue": "Inactive",
        "instance": 4,
        "eventState": "normal",
        "outOfService": false,
        "description": "",
        "objectName": "Binary Output 4",
        "priorityArray": [
            null,
            null,
            null,
```

```
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null
        ],
        "objectType": 4,
        "relinquishDefault": "Inactive",
        "success": true
    },
    {
        "presentValue": "Inactive",
        "instance": 3,
        "eventState": "normal",
        "outOfService": false,
        "description": "",
        "objectName": "Binary Output 3",
        "priorityArray": [
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null
        ],
        "objectType": 4,
        "relinquishDefault": "Inactive",
        "success": true
    },
    {
        "presentValue": "Inactive",
        "instance": 2,
        "eventState": "normal",
        "outOfService": false,
        "description": "",
        "objectName": "Binary Output 2",
        "priorityArray": [
            null,
            null,
```

```
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null
        ],
        "objectType": 4,
        "relinquishDefault": "Inactive",
        "success": true
    },
    {
        "presentValue": "Active",
        "instance": 1,
        "eventState": "normal",
        "outOfService": false,
        "description": "Time  Commanded BO",
        "objectName": "Binary Output 1",
        "priorityArray": [
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            null,
            "Active"
        ],
        "objectType": 4,
        "relinquishDefault": "Inactive",
        "success": true
    }
]
```

Request Method	GET
URL	/api/bi/:instance /api/bv/:instance /api/bo/:instance
Response	BI/BV/BO
Accessible By	0, 1, 3

Gets binary by instance number.

Request:
GET https://192.168.1.1/api/bo/1

Response:


```
{
   "presentValue": "Active",
    "instance": 1,
    "eventState": "normal",
    "outOfService": false,
    "description": "Time  Commanded BO",
    "objectName": "Binary Output 1",
    "priorityArray": [
        null,
        null,
        null,
        null,
        null,
        null,
        null,
        null,
        null,
        null,
        null,
        null,
        null,
        null,
        null,
        null,
        "Active"
    ],
    "objectType": 4,
    "relinquishDefault": "Inactive"
}
```

Request Method	POST
URL	/api/bv/:instance /api/bo/:instance /api/bi/:instance
Body (required)	property: <refer to properties> value: string arrayIndex: string
Accessible By	0, 1, 3

Writes a single property to a binary value or binary output.
Optional body is only relevant to binary outputs.

Request:
POST https://192.168.1.1/api/bo/6

Body:
{"value":"Active","arrayIndex":8,"property":"presentValue"}

Response:

```
{
    "presentValue": "Active",
    "instance": 6,
    "eventState": "normal",
    "outOfService": false,
    "description": "",
    "objectName": "Binary Output 6",
    "priorityArray": [
        null,
        null,
        null,
        null,
        null,
        null,
        null,
        "Active",
        null,
        null,
        null,
        null,
        null,
        null,
        null,
        null
    ],
    "objectType": "binaryOutput",
    "relinquishDefault": "Inactive"}
```

11. Glossary (Enumerations)

11.1. BACnet Objects

analogInput = 0,
analogOutput = 1,
analogValue = 2,
binaryInput = 3,
binaryOutput = 4,
binaryValue = 5,
calendar = 6,
command = 7,
device = 8,
eventEnrollment = 9,
file = 10,
group = 11,
loop = 12,
multiStateInput = 13,
multiStateOutput = 14,
notificationClass = 15,
program = 16,
schedule = 17,
averaging = 18,
multiStateValue = 19,
trendlog = 20,
lifeSafetyPoint = 21,
lifeSafetyZone = 22,
accumulator = 23,
pulseConverter = 24,
eventLog = 25,
globalGroup = 26,
trendlogMultiple = 27

11.2. AI Mode

{"mode": "2"} 10k-2 sensor
{"mode": "6"} Dry Contact
{"mode": "4|10"} Pulse 10 per pulse
{"mode": "3|0|100"} 4-20 ma 0 to 100
{"mode": "5"} 3K sensor

11.3. Reliability

noFaultDetected = 0,
noSensor = 1,
overRange = 2,
underRange = 3,

openLoop = 4,
shortedLoop = 5,
noOutput = 6,
unreliableOther = 7,
processError = 8,
multiStateFault = 9,
configurationError = 10,
communicationFailure = 12,
memberFault = 13,
monitoredObjectFault = 14,
tripped = 15

11.4. BACnet Property

ackedTransitions = 0,
ackRequired = 1,
action = 2,
actionText = 3,
activeText = 4,
activeVtSessions = 5,
alarmValue = 6,
alarmValues = 7,
all = 8,
allWritesSuccessful = 9,
apduSegmentTimeout = 10,
apduTimeout = 11,
applicationSoftwareVersion = 12,
archive = 13,
bias = 14,
changeOfStateCount = 15,
changeOfStateTime = 16,
notificationClass = 17,
controlledVariableReference = 19,
controlledVariableUnits = 20,
controlledVariableValue = 21,
covIncrement = 22,
dateList = 23,
daylightSavingsStatus = 24,
deadband = 25,
derivativeConstant = 26,
derivativeConstantUnits = 27,
description = 28,
descriptionOfHalt = 29,
deviceAddressBinding = 30,
deviceType = 31,
effectivePeriod = 32,
elapsedActiveTime = 33,
errorLimit = 34,
eventEnable = 35,

eventState = 36,
eventType = 37,
exceptionSchedule = 38,
faultValues = 39,
feedbackValue = 40,
fileAccessMethod = 41,
fileSize = 42,
fileType = 43,
firmwareRevision = 44,
highLimit = 45,
inactiveText = 46,
inProcess = 47,
instanceOf = 48,
integralConstant = 49,
integralConstantUnits = 50,
limitEnable = 52,
listOfGroupMembers = 53,
listOfObjectPropertyReferences = 54,
localDate = 56,
localTime = 57,
location = 58,
lowLimit = 59,
manipulatedVariableReference = 60,
maximumOutput = 61,
maxApduLengthAccepted = 62,
maxInfoFrames = 63,
maxMaster = 64,
maxPresValue = 65,
minimumOffTime = 66,
minimumOnTime = 67,
minimumOutput = 68,
minPresValue = 69,
modelName = 70,
modificationDate = 71,
notifyType = 72,
numberOfApduRetries = 73,
numberOfStates = 74,
objectIdentifier = 75,
objectList = 76,
objectName = 77,
objectPropertyReference = 78,
objectType = 79,
optional = 80,
outOfService = 81,
outputUnits = 82,
eventParameters = 83,
polarity = 84,
presentValue = 85,
priority = 86,

priorityArray = 87,
priorityForWriting = 88,
processIdentifier = 89,
programChange = 90,
programLocation = 91,
programState = 92,
proportionalConstant = 93,
proportionalConstantUnits = 94,
protocolObjectTypesSupported = 96,
protocolServicesSupported = 97,
protocolVersion = 98,
readOnly = 99,
reasonForHalt = 100,
recipientList = 102,
reliability = 103,
relinquishDefault = 104,
required = 105,
resolution = 106,
segmentationSupported = 107,
setpoint = 108,
setpointReference = 109,
stateText = 110,
statusFlags = 111,
systemStatus = 112,
timeDelay = 113,
timeOfActiveTimeReset = 114,
timeOfStateCountReset = 115,
timeSynchronizationRecipients = 116,
units = 117,
updateInterval = 118,
utcOffset = 119,
vendorIdentifier = 120,
vendorName = 121,
vtClassesSupported = 122,
weeklySchedule = 123,
attemptedSamples = 124,
averageValue = 125,
bufferSize = 126,
clientCovIncrement = 127,
covResubscriptionInterval = 128,
eventTimeStamps = 130,
logBuffer = 131,
logDeviceObjectProperty = 132,
enable = 133,
logInterval = 134,
maximumValue = 135,
minimumValue = 136,
notificationThreshold = 137,
protocolRevision = 139,

recordsSinceNotification = 140,
recordCount = 141,
startTime = 142,
stopTime = 143,
stopWhenFull = 144,
totalRecordCount = 145,
validSamples = 146,
windowInterval = 147,
windowSamples = 148,
maximumValueTimestamp = 149,
minimumValueTimestamp = 150,
varianceValue = 151,
activeCovSubscriptions = 152,
backupFailureTimeout = 153,
configurationFiles = 154,
databaseRevision = 155,
directReading = 156,
lastRestoreTime = 157,
maintenanceRequired = 158,
memberOf = 159,
mode = 160,
operationExpected = 161,
setting = 162,
silenced = 163,
trackingValue = 164,
zoneMembers = 165,
lifeSafetyAlarmValues = 166,
maxSegmentsAccepted = 167,
profileName = 168,
autoSlaveDiscovery = 169,
manualSlaveAddressBinding = 170,
slaveAddressBinding = 171,
slaveProxyEnable = 172,
lastNotifyRecord = 173,
scheduleDefault = 174,
acceptedModes = 175,
adjustValue = 176,
count = 177,
countBeforeChange = 178,
countChangeTime = 179,
covPeriod = 180,
inputReference = 181,
limitMonitoringInterval = 182,
loggingObject = 183,
loggingRecord = 184,
prescale = 185,
pulseRate = 186,
scale = 187,
scaleFactor = 188,

updateTime = 189,
valueBeforeChange = 190,
valueSet = 191,
valueChangeTime = 192,
alignIntervals = 193,
intervalOffset = 195,
lastRestartReason = 196,
loggingType = 197,
restartNotificationRecipients = 202,
timeOfDeviceRestart = 203,
timeSynchronizationInterval = 204,
trigger = 205,
utcTimeSynchronizationRecipients = 206,
nodeSubtype = 207,
nodeType = 208,
structuredObjectList = 209,
subordinateAnnotations = 210,
subordinateList = 211,
actualShedLevel = 212,
dutyWindow = 213,
expectedShedLevel = 214,
fullDutyBaseline = 215,
requestedShedLevel = 218,
shedDuration = 219,
shedLevelDescriptions = 220,
shedLevels = 221,
stateDescription = 222,
doorAlarmState = 226,
doorExtendedPulseTime = 227,
doorMembers = 228,
doorOpenTooLongTime = 229,
doorPulseTime = 230,
doorStatus = 231,
doorUnlockDelayTime = 232,
lockStatus = 233,
maskedAlarmValues = 234,
securedStatus = 235,
absenteeLimit = 244,
accessAlarmEvents = 245,
accessDoors = 246,
accessEvent = 247,
accessEventAuthenticationFactor = 248,
accessEventCredential = 249,
accessEventTime = 250,
accessTransactionEvents = 251,
accompaniment = 252,
accompanimentTime = 253,
activationTime = 254,
activeAuthenticationPolicy = 255,

assignedAccessRights = 256,
authenticationFactors = 257,
authenticationPolicyList = 258,
authenticationPolicyNames = 259,
authenticationStatus = 260,
authorizationMode = 261,
belongsTo = 262,
credentialDisable = 263,
credentialStatus = 264,
credentials = 265,
credentialsInZone = 266,
daysRemaining = 267,
entryPoints = 268,
exitPoints = 269,
expiryTime = 270,
extendedTimeEnable = 271,
failedAttemptEvents = 272,
failedAttempts = 273,
failedAttemptsTime = 274,
lastAccessEvent = 275,
lastAccessPoint = 276,
lastCredentialAdded = 277,
lastCredentialAddedTime = 278,
lastCredentialRemoved = 279,
lastCredentialRemovedTime = 280,
lastUseTime = 281,
lockout = 282,
lockoutRelinquishTime = 283,
maxFailedAttempts = 285,
members = 286,
musterPoint = 287,
negativeAccessRules = 288,
numberOfAuthenticationPolicies = 289,
occupancyCount = 290,
occupancyCountAdjust = 291,
occupancyCountEnable = 292,
occupancyLowerLimit = 294,
occupancyLowerLimitEnforced = 295,
occupancyState = 296,
occupancyUpperLimit = 297,
occupancyUpperLimitEnforced = 298,
passbackMode = 300,
passbackTimeout = 301,
positiveAccessRules = 302,
reasonForDisable = 303,
supportedFormats = 304,
supportedFormatClasses = 305,
threatAuthority = 306,
threatLevel = 307,

traceFlag = 308,
transactionNotificationClass = 309,
userExternalIdentifier = 310,
userInformationReference = 311,
userName = 317,
userType = 318,
usesRemaining = 319,
zoneFrom = 320,
zoneTo = 321,
accessEventTag = 322,
globalIdentifier = 323,
verificationTime = 326,
baseDeviceSecurityPolicy = 327,
distributionKeyRevision = 328,
doNotHide = 329,
keySets = 330,
lastKeyServer = 331,
networkAccessSecurityPolicies = 332,
packetReorderTime = 333,
securityPduTimeout = 334,
securityTimeWindow = 335,
supportedSecurityAlgorithms = 336,
updateKeySetTimeout = 337,
backupAndRestoreState = 338,
backupPreparationTime = 339,
restoreCompletionTime = 340,
restorePreparationTime = 341,
bitMask = 342,
bitText = 343,
isUtc = 344,
groupMembers = 345,
groupMemberNames = 346,
memberStatusFlags = 347,
requestedUpdateInterval = 348,
covuPeriod = 349,
covuRecipients = 350,
eventMessageTexts = 351,
eventMessageTextsConfig = 352,
eventDetectionEnable = 353,
eventAlgorithmInhibit = 354,
eventAlgorithmInhibitRef = 355,
timeDelayNormal = 356,
reliabilityEvaluationInhibit = 357,
faultParameters = 358,
faultType = 359,
localForwardingOnly = 360,
processIdentifierFilter = 361,
subscribedRecipients = 362,
portFilter = 363,

authorizationExemptions = 364,
allowGroupDelayInhibit = 365,
channelNumber = 366,
controlGroups = 367,
executionDelay = 368,
lastPriority = 369,
writeStatus = 370,
propertyList = 371,
serialNumber = 372,
blinkWarnEnable = 373,
defaultFadeTime = 374,
defaultRampRate = 375,
defaultStepIncrement = 376,
egressTime = 377,
inProgress = 378,
instantaneousPower = 379,
lightingCommand = 380,
lightingCommandDefaultPriority = 381,
maxActualValue = 382,
minActualValue = 383,
power = 384,
transition = 385,
egressActive = 386,
alerWeeklyScheduleInputs = 1073,
alerWeeklyScheduleObjects = 1074,
alerHolidayScheduleInput = 1075,
alerHolidayScheduleObject = 1076,
alerEventScheduleInputs = 1077,
alerEventScheduleObjects = 1078,
alerOccupiedCmdReference = 1100,
alerWarmupCmdReference = 1102,
alerCooldownCmdReference = 1104,
alerTenantOverrideReference = 1112

11.5. Aux Com Option

disabled = 0,
BACnet Segregated = 1,
BACnet Routed to IP = 2,
BACnet Routed to MSTP = 3,
BACnet Routed = 4,
Modbus Routed = 5

11.6. BACnet Event Type

changeOfBitString = 0,
changeOfState = 1,
changeOfValue = 2,

commandFailure = 3,
floatingLimit = 4,
outOfRange = 5,
none = 20

11.7. BACnet Notify Type

alarm = 0,
event = 1,
ackedNotification = 2

11.8. BACnet Event State

normal = 0,
fault = 1,
offNormal = 2,
highLimit = 3,
lowLimit = 4,
lifeSafetyAlarm = 5

11.9. Logging Type

polled = 0,
cov = 1,
triggered = 2

11.10. Day of Week

Monday = 1,
Tuesday = 2,
Wednesday = 3,
Thursday = 4,
Friday = 5,
Saturday = 6,
Sunday = 7,
Unspecified = 255

11.11. BACnet Date

An array of length four where:
Year = 0 index; number
must be between 1 and 254 (inclusive), where as per bacnet standard years should be subtracted from 1900
Month = 1st index; BACnetMonth
Day = 2nd index
DayOfWeek = 3rd index where value MUST be 255

11.12. BACnet Month

January = 1,
February = 2,
March = 3,
April = 4,
May = 5,
June = 6,
July = 7,
August = 8,
September = 9,
October = 10,
November = 11,
December = 12,
OddMonths = 13,
EvenMonths = 14,
Unspecified = 255

11.13. BACnet Value Choice

Null = 0,
UnsignedInteger = 2,
SignedInteger = 3,
Real = 4,
Double = 5,
OctetString = 6,
BitString = 8

11.14. Schedule Period Choice

periodChoiceCalendar = 0,
periodChoiceDate = 1,
periodChoiceDateRange = 2,
periodChoiceSpecial = 3