

**OCF “Essen” – SAFE: PV system – Data Model WG CR 2916**

Legal Disclaimer

THIS IS A DRAFT SPECIFICATION DOCUMENT ONLY AND HAS NOT BEEN ADOPTED BY THE OPEN CONNECTIVITY FOUNDATION. THIS DRAFT DOCUMENT MAY NOT BE RELIED UPON FOR ANY PURPOSE OTHER THAN REVIEW OF THE CURRENT STATE OF THE DEVELOPMENT OF THIS DRAFT DOCUMENT. THE OPEN CONNECTIVITY FOUNDATION AND ITS MEMBERS RESERVE THE RIGHT WITHOUT NOTICE TO YOU TO CHANGE ANY OR ALL PORTIONS HEREOF, DELETE PORTIONS HEREOF, MAKE ADDITIONS HERETO, DISCARD THIS DRAFT DOCUMENT IN ITS ENTIRETY OR OTHERWISE MODIFY THIS DRAFT DOCUMENT AT ANY TIME. YOU SHOULD NOT AND MAY NOT RELY UPON THIS DRAFT DOCUMENT IN ANY WAY, INCLUDING BUT NOT LIMITED TO THE DEVELOPMENT OF ANY PRODUCTS OR SERVICES. IMPLEMENTATION OF THIS DRAFT DOCUMENT IS DONE AT YOUR OWN RISK AMEND AND IT IS NOT SUBJECT TO ANY LICENSING GRANTS OR COMMITMENTS UNDER THE OPEN CONNECTIVITY FOUNDATION INTELLECTUAL PROPERTY RIGHTS POLICY OR OTHERWISE. IN CONSIDERATION OF THE OPEN CONNECTIVITY FOUNDATION GRANTING YOU ACCESS TO THIS DRAFT DOCUMENT, YOU DO HEREBY WAIVE ANY AND ALL CLAIMS ASSOCIATED HERewith INCLUDING BUT NOT LIMITED TO THOSE CLAIMS DISCUSSED BELOW, AS WELL AS CLAIMS OF DETRIMENTAL RELIANCE.

The OCF logo is a trademark of Open Connectivity Foundation, Inc. in the United States or other countries. \*Other names and brands may be claimed as the property of others.

Copyright © 2019 Open Connectivity Foundation, Inc. All rights reserved.

Copying or other form of reproduction and/or distribution of these works are strictly prohibited.

## 1.1 Battery

### 1.1.1 Introduction

This Resource describes the attributes associated with a battery. The Property "charge" is an integer showing the current battery charge level as a percentage in the range 0 (fully discharged) to 100 (fully charged). The Property "capacity" represents the total capacity of battery in Amp Hours (Ah). The "charging" status and "discharging" status are represented by boolean values set to "true" indicating enabled and "false" indicating disabled. Low battery status is represented by a boolean value set to "true" indicating low charge level and "false" indicating otherwise, based upon the battery threshold represented as a percentage.

### 1.1.2 Example URI

/BatteryResURI

### 1.1.3 Resource type

The Resource Type is defined as: "oic.r.energy.battery".

### 1.1.4 OpenAPI 2.0 definition

```
{
  "swagger": "2.0",
  "info": {
    "title": "Battery",
    "version": "20190618",
    "license": {
      "name": "OCF Data Model License",
      "url":
"https://github.com/openconnectivityfoundation/core/blob/e28a9e0a92e17042ba3e83661e4c0fbce8bdc4b
a/LICENSE.md",
      "x-copyright": "Copyright 2018-2019 Open Connectivity Foundation, Inc. All rights
reserved."
    },
    "termsOfService": "https://openconnectivityfoundation.github.io/core/DISCLAIMER.md"
  },
  "schemes": ["http"],
  "consumes": ["application/json"],
  "produces": ["application/json"],
  "paths": {
    "/BatteryResURI" : {
      "get": {
        "description": "This Resource describes the attributes associated with a battery. The
Property \"charge\" is an integer showing the current battery charge level as a percentage in
the range 0 (fully discharged) to 100 (fully charged). The Property \"capacity\" represents the
total capacity of battery in Amp Hours (Ah). The \"charging\" status and \"discharging\" status
are represented by boolean values set to \"true\" indicating enabled and \"false\" indicating
disabled. Low battery status is represented by a boolean value set to \"true\" indicating low
charge level and \"false\" indicating otherwise, based upon the battery threshold represented as
a percentage.",
        "parameters": [
          { "$ref": "#/parameters/interface" }
        ],
        "responses": {
          "200": {
            "description": "",
            "x-example":
{
              "rt": ["oic.r.energy.battery"],
              "if": ["oic.if.rw", "oic.if.baseline"],
              "charge": 50,
              "capacity": 3000,
              "charging": true,
              "discharging": false,
              "lowbattery": false,
              "batterythreshold": 20,
              "defect": false,
              "timestamp": "2015-11-05T14:30:00.20Z"
            }
          }
        }
      }
    }
  }
}
```

```

    },
    "schema": { "$ref": "#/definitions/Battery" }
  }
},
"post": {
  "description": "Sets current battery values\n",
  "parameters": [
    { "$ref": "#/parameters/interface" },
    {
      "name": "body",
      "in": "body",
      "required": true,
      "schema": { "$ref": "#/definitions/BatteryUpdate" },
      "x-example":
        {
          "batterythreshold": 20
        }
    }
  ],
  "responses": {
    "200": {
      "description": "",
      "x-example":
        {
          "batterythreshold": 20
        },
      "schema": { "$ref": "#/definitions/BatteryUpdate" }
    }
  }
},
},
"parameters": {
  "interface": {
    "in": "query",
    "name": "if",
    "type": "string",
    "enum": ["oic.if.rw", "oic.if.baseline"]
  }
},
"definitions": {
  "Battery": {
    "properties": {
      "rt": {
        "description": "The Resource Type.",
        "items": {
          "enum": ["oic.r.energy.battery"],
          "maxLength": 64,
          "type": "string"
        },
        "minItems": 1,
        "uniqueItems": true,
        "readOnly": true,
        "type": "array"
      },
      "discharging": {
        "description": "The status of discharging.",
        "readOnly": true,
        "type": "boolean"
      },
      "lowbattery": {
        "description": "The status of the low battery warning based upon the defined
threshold.",
        "readOnly": true,
        "type": "boolean"
      },
      "capacity": {
        "description": "The total capacity in Amp-hours (Ah).",
        "readOnly": true,
        "type": "number"
      }
    }
  }
}

```

```

    },
    "batterythreshold": {
      "description": "The threshold percentage for the low battery warning.",
      "maximum": 100,
      "minimum": 0,
      "type": "integer"
    },
    "charge": {
      "description": "The current charge percentage.",
      "maximum": 100,
      "minimum": 0,
      "readOnly": true,
      "type": "integer"
    },
    "charging": {
      "description": "The status of charging.",
      "readOnly": true,
      "type": "boolean"
    },
    "defect": {
      "description": "Battery defect detected. True = defect, False = no defect",
      "readOnly": true,
      "type": "boolean"
    },
    "timestamp": {
      "description": "An RFC3339 formatted time indicating when the data was observed (e.g.:
2016-02-15T09:19Z, 1996-12-19T16:39:57-08:00). Note that 1/100 time resolution should be used.",
      "format": "date-time",
      "readOnly": true,
      "type": "string"
    },
    "n": {
      "$ref":
"https://openconnectivityfoundation.github.io/core/schemas/oic.common.properties.core-
schema.json#/definitions/n"
    },
    "id": {
      "$ref":
"https://openconnectivityfoundation.github.io/core/schemas/oic.common.properties.core-
schema.json#/definitions/id"
    },
    "if": {
      "description": "The OCF Interface set supported by this Resource.",
      "items": {
        "enum": [
          "oic.if.rw",
          "oic.if.baseline"
        ],
        "type": "string"
      },
      "minItems": 2,
      "uniqueItems": true,
      "readOnly": true,
      "type": "array"
    }
  },
  "type" : "object",
  "required": ["charge"]
},
"BatteryUpdate": {
  "properties": {
    "batterythreshold": {
      "description": "The threshold percentage for the low battery warning.",
      "maximum": 100,
      "minimum": 0,
      "type": "integer"
    }
  },
  "type" : "object",
  "required": ["batterythreshold"]
}

```

```

}
}

```

### 1.1.5 Property definition

<Table Reference Here> defines the Properties that are part of the "oic.r.energy.battery" Resource Type.

**Table 1 – The Property definitions of the Resource with type "rt" = "oic.r.energy.battery".**

Property name	Value type	Mandatory	Access mode	Description
lowbattery	boolean	No	Read Only	The status of the low battery warning based upon the defined threshold.
n	multiple types: see schema	No	Read Write	
capacity	number	No	Read Only	The total capacity in Amp-hours (Ah).
batterythreshold	integer	No	Read Write	The threshold percentage for the low battery warning.
discharging	boolean	No	Read Only	The status of discharging.
charging	boolean	No	Read Only	The status of charging.
if	array: see schema	No	Read Only	The OCF Interface set supported by this Resource.
timestamp	string	No	Read Only	An RFC3339 formatted time indicating when the data was observed (e.g.: 2016-02-15T09:19Z, 1996-12-19T16:39:57-08:00). Note that 1/100 time resolution should be used.
charge	integer	Yes	Read Only	The current charge percentage.
defect	boolean	No	Read Only	Battery defect detected. True = defect, False = no defect
id	multiple types: see schema	No	Read Write	

rt	array: see schema	No	Read Only	The Resource Type.
batterythreshold	integer	Yes	Read Write	The threshold percentage for the low battery warning.

### 1.1.6 CRUDN behaviour

<Table Reference Here> defines the CRUDN operations that are supported on the "oic.r.energy.battery" Resource Type.

**Table 2 – The CRUDN operations of the Resource with type "rt" = "oic.r.energy.battery".**

Create	Read	Update	Delete	Notify
	get	post		observe

## 1.2 Circuit Breaker (IEC 61850)

### 1.2.1 Introduction

This Resource describes functions for the control and monitoring of IEC 61850 based circuit breaker.

### 1.2.2 Example URI

/CircuitBreakerResURI

### 1.2.3 Resource type

The Resource Type is defined as: "oic.r.circuitbreaker".

### 1.2.4 OpenAPI 2.0 definition

```
{
  "swagger": "2.0",
  "info": {
    "title": "Circuit Breaker (IEC 61850)",
    "version": "20190613",
    "license": {
      "name": "OCF Data Model License",
      "url":
"https://github.com/openconnectivityfoundation/core/blob/e28a9e0a92e17042ba3e83661e4c0fbce8bdc4b
a/LICENSE.md",
      "x-copyright": "copyright 2019 Open Connectivity Foundation, Inc. All rights reserved."
    },
    "termsOfService": "https://openconnectivityfoundation.github.io/core/DISCLAIMER.md"
  },
  "schemes": ["http"],
  "consumes": ["application/json"],
  "produces": ["application/json"],
  "paths": {
    "/CircuitBreakerResURI" : {
      "get": {
        "description": "This Resource describes functions for the control and monitoring of IEC
61850 based circuit breaker.",
        "parameters": [
          {"$ref": "#/parameters/interface"}
        ],
        "responses": {
          "200": {
            "description": "",
            "x-example":
{
              "rt": ["oic.r.circuitbreaker"],
              "if": ["oic.if.s", "oic.if.baseline"],
              "status": "on",
              "ratedcurrent": 10.0,
            }
          }
        }
      }
    }
  }
}
```



```

    "readOnly": true,
    "type": "string"
  },
  "n": {
    "$ref":
"https://openconnectivityfoundation.github.io/core/schemas/oic.common.properties.core-
schema.json#/definitions/n"
  },
  "id": {
    "$ref":
"https://openconnectivityfoundation.github.io/core/schemas/oic.common.properties.core-
schema.json#/definitions/id"
  },
  "if": {
    "description": "The OCF Interface set supported by this Resource.",
    "items": {
      "enum": [
        "oic.if.s",
        "oic.if.baseline"
      ],
      "type": "string"
    },
    "minItems": 2,
    "uniqueItems": true,
    "readOnly": true,
    "type": "array"
  }
},
"type": "object",
"required": ["status", "ratedcurrent", "ratedbreakingcurrent", "ratedvoltage",
"timestamp"]
}
}
}

```

### 1.2.5 Property definition

<Table Reference Here> defines the Properties that are part of the "oic.r.circuitbreaker" Resource Type.

**Table 3 – The Property definitions of the Resource with type "rt" = "oic.r.circuitbreaker".**

Property name	Value type	Mandatory	Access mode	Description
id	multiple types: see schema	No	Read Write	
ratedvoltage	number	Yes	Read Only	The rated voltage in Volts, defined at manufacturing time.
ratedbreakingcurrent	number	Yes	Read Only	The rated breaking current in Ampere, defined at manufacturing time.
n	multiple types: see schema	No	Read Write	
ratedcurrent	number	Yes	Read Only	The rated current in Ampere, defined at



				manufacturing time.
if	array: see schema	No	Read Only	The OCF Interface set supported by this Resource.
leakagecurrent	number	No	Read Only	The leakage current in mA.
timestamp	string	Yes	Read Only	An RFC3339 formatted time indicating when the data was observed (e.g.: 2016-02-15T09:19Z, 1996-12-19T16:39:57-08:00). Note that 1/100 time resolution should be used.
rt	array: see schema	No	Read Only	The Resource Type
insulationresistance	number	No	Read Only	Insulation resistance of circuit breaker (M Ohm).
status	string	Yes	Read Only	The circuit breaker status. The status can only be reset out of bounds.

### 1.2.6 CRUDN behaviour

<Table Reference Here> defines the CRUDN operations that are supported on the "oic.r.circuitbreaker" Resource Type.

**Table 4 – The CRUDN operations of the Resource with type "rt" = "oic.r.circuitbreaker".**

Create	Read	Update	Delete	Notify
	get			observe

## 1.3 Inverter (IEC 61850)

### 1.3.1 Introduction

This Resource describes functions for the control and monitoring of IEC 61850 based circuit breaker.

### 1.3.2 Example URI

/InverterResURI

### 1.3.3 Resource type

The Resource Type is defined as: "oic.r.inverter".

### 1.3.4 OpenAPI 2.0 definition

```

{
  "swagger": "2.0",
  "info": {
    "title": "Inverter (IEC 61850)",
    "version": "20190613",
    "license": {
      "name": "OCF Data Model License",
      "url":
"https://github.com/openconnectivityfoundation/core/blob/e28a9e0a92e17042ba3e83661e4c0fbce8bdc4b
a/LICENSE.md",
      "x-copyright": "copyright 2019 Open Connectivity Foundation, Inc. All rights reserved."
    },
    "termsOfService": "https://openconnectivityfoundation.github.io/core/DISCLAIMER.md"
  },
  "schemes": ["http"],
  "consumes": ["application/json"],
  "produces": ["application/json"],
  "paths": {
    "/InverterResURI" : {
      "get": {
        "description": "This Resource describes functions for the control and monitoring of IEC
61850 based circuit breaker.",
        "parameters": [
          { "$ref": "#/parameters/interface" }
        ],
        "responses": {
          "200": {
            "description" : "",
            "x-example":
            {
              "rt": ["oic.r.inverter"],
              "if": ["oic.if.s", "oic.if.baseline"],
              "status": "on",
              "ratedpower": 36.0,
              "minvoltmppt": 200.0,
              "maxvoltmppt": 1000.0,
              "inputvoltage": 980.0,
              "inputcurrent": 22.0,
              "outputpower": 61.0,
              "timestamp": "2015-11-05T14:30:00.13Z"
            },
            "schema": { "$ref": "#/definitions/Inverter" }
          }
        }
      }
    }
  },
  "parameters": {
    "interface" : {
      "in": "query",
      "name": "if",
      "type": "string",
      "enum": ["oic.if.s", "oic.if.baseline"]
    }
  },
  "definitions": {
    "Inverter" : {
      "properties": {
        "rt" : {
          "description": "The Resource Type",
          "items": {
            "enum": ["oic.r.inverter"],
            "maxLength": 64,
            "type": "string"
          },
          "minItems": 1,
          "uniqueItems": true,
          "readOnly": true,
          "type": "array"
        }
      }
    }
  }
}

```

```

    },
    "status" : {
      "description": "The inverter status. The status can only be reset out of bounds.",
      "readOnly": true,
      "type": "string",
      "enum" : [ "on", "off", "trip"]
    },
    "ratedpower" : {
      "description": "The rated power in kW, defined at manufacturing time.",
      "readOnly": true,
      "type": "number"
    },
    "minvoltmppt" : {
      "description": "Minimum voltage for MPPT (Maximum power point tracking) control method
(V), defined at manufacturing time.",
      "readOnly": true,
      "type": "number"
    },
    "maxvoltmppt" : {
      "description": "Maximum voltage for MPPT (Maximum power point tracking) control method
(V), defined at manufacturing time.",
      "readOnly": true,
      "type": "number"
    },
    "inputvoltage" : {
      "description": "input voltage in Volts.",
      "readOnly": true,
      "type": "number"
    },
    "inputcurrent" : {
      "description": "input current in Amperes.",
      "readOnly": true,
      "type": "number"
    },
    "outputpower" : {
      "description": "output power in kW.",
      "readOnly": true,
      "type": "number"
    },
    "timestamp": {
      "description": "An RFC3339 formatted time indicating when the data was observed (e.g.:
2016-02-15T09:19Z, 1996-12-19T16:39:57-08:00). Resolution in 1/100 second.",
      "format": "date-time",
      "readOnly": true,
      "type": "string"
    },
    "n": {
      "$ref":
"https://openconnectivityfoundation.github.io/core/schemas/oic.common.properties.core-
schema.json#/definitions/n"
    },
    "id": {
      "$ref":
"https://openconnectivityfoundation.github.io/core/schemas/oic.common.properties.core-
schema.json#/definitions/id"
    },
    "if": {
      "description": "The OCF Interface set supported by this Resource.",
      "items": {
        "enum": [
          "oic.if.s",
          "oic.if.baseline"
        ],
        "type": "string"
      },
      "minItems": 2,
      "uniqueItems": true,
      "readOnly": true,
      "type": "array"
    }
  }
},

```

```

    "type": "object",
    "required": ["status", "ratedpower", "minvoltmppt", "maxvoltmppt",
"inputvoltage", "inputcurrent", "outputpower", "timestamp" ]
  }
}
}

```

### 1.3.5 Property definition

<Table Reference Here> defines the Properties that are part of the "oic.r.inverter" Resource Type.

**Table 5 – The Property definitions of the Resource with type "rt" = "oic.r.inverter".**

Property name	Value type	Mandatory	Access mode	Description
if	array: see schema	No	Read Only	The OCF Interface set supported by this Resource.
id	multiple types: see schema	No	Read Write	
maxvoltmppt	number	Yes	Read Only	Maximum voltage for MPPT (Maximum power point tracking) control method (V), defined at manufacturing time.
rt	array: see schema	No	Read Only	The Resource Type
timestamp	string	Yes	Read Only	An RFC3339 formatted time indicating when the data was observed (e.g.: 2016-02-15T09:19Z, 1996-12-19T16:39:57-08:00). Resolution in 1/100 second.
status	string	Yes	Read Only	The inverter status. The status can only be reset out of bounds.
outputpower	number	Yes	Read Only	output power in kW.
ratedpower	number	Yes	Read Only	The rated power in kW, defined at manufacturing time.

inputcurrent	number	Yes	Read Only	input current in Amperes.
inputvoltage	number	Yes	Read Only	input voltage in Volts.
minvoltmppt	number	Yes	Read Only	Minimum voltage for MPPT (Maximum power point tracking) control method (V), defined at manufacturing time.
n	multiple types: see schema	No	Read Write	

### 1.3.6 CRUDN behaviour

<Table Reference Here> defines the CRUDN operations that are supported on the "oic.r.inverter" Resource Type.

**Table 6 – The CRUDN operations of the Resource with type "rt" = "oic.r.inverter".**

Create	Read	Update	Delete	Notify
	get			observe

## 1.4 PV array system connection terminal (IEC 61850)

### 1.4.1 Introduction

This Resource describes functions for the control and monitoring of IEC 61850 based PV Array system connection terminal.

### 1.4.2 Example URI

/PVConnectionTerminalResURI

### 1.4.3 Resource type

The Resource Type is defined as: "oic.r.pvconnectionterminal".

### 1.4.4 OpenAPI 2.0 definition

```
{
  "swagger": "2.0",
  "info": {
    "title": "PV array system connection terminal (IEC 61850)",
    "version": "20190613",
    "license": {
      "name": "OCF Data Model License",
      "url":
"https://github.com/openconnectivityfoundation/core/blob/e28a9e0a92e17042ba3e83661e4c0fbce8bdc4b
a/LICENSE.md",
      "x-copyright": "copyright 2019 Open Connectivity Foundation, Inc. All rights reserved."
    },
    "termsOfService": "https://openconnectivityfoundation.github.io/core/DISCLAIMER.md"
  },
  "schemes": ["http"],
  "consumes": ["application/json"],
  "produces": ["application/json"],
  "paths": {
    "/PVConnectionTerminalResURI" : {
      "get": {
        "description": "This Resource describes functions for the control and monitoring of IEC
61850 based PV Array system connection terminal.",

```



```

    "readOnly": true,
    "type": "number"
  },
  "insulationresistance" : {
    "description": "Insulation resistance of circuit breaker (M Ohm).",
    "readOnly": true,
    "type": "number"
  },
  "timestamp": {
    "description": "An RFC3339 formatted time indicating when the data was observed (e.g.:
2016-02-15T09:19Z, 1996-12-19T16:39:57-08:00). Note that 1/100 time resolution should be used.",
    "format": "date-time",
    "readOnly": true,
    "type": "string"
  },
  "n": {
    "$ref":
"https://openconnectivityfoundation.github.io/core/schemas/oic.common.properties.core-
schema.json#/definitions/n"
  },
  "id": {
    "$ref":
"https://openconnectivityfoundation.github.io/core/schemas/oic.common.properties.core-
schema.json#/definitions/id"
  },
  "if": {
    "description": "The OCF Interface set supported by this Resource.",
    "items": {
      "enum": [
        "oic.if.s",
        "oic.if.baseline"
      ],
      "type": "string"
    },
    "minItems": 2,
    "uniqueItems": true,
    "readOnly": true,
    "type": "array"
  }
},
"type": "object",
"required": ["ratedarrayvoltage", "ratedarraycurrent", "arrayvoltage", "arraycurrent",
"timestamp"]
}
}
}

```

#### 1.4.5 Property definition

<Table Reference Here> defines the Properties that are part of the "oic.r.pvconnectionterminal" Resource Type.

**Table 7 – The Property definitions of the Resource with type "rt" = "oic.r.pvconnectionterminal".**

Property name	Value type	Mandatory	Access mode	Description
id	multiple types: see schema	No	Read Write	
arrayvoltage	number	Yes	Read Only	Output voltage of array in volts (V).
ratedarrayvoltage	number	Yes	Read Only	Rated voltage of array (Nominal values of maximum power voltage *)

				number of modules) (V)
n	multiple types: see schema	No	Read Write	
insulationresistance	number	No	Read Only	Insulation resistance of circuit breaker (M Ohm).
rt	array: see schema	No	Read Only	The Resource Type
timestamp	string	Yes	Read Only	An RFC3339 formatted time indicating when the data was observed (e.g.: 2016-02-15T09:19Z, 1996-12-19T16:39:57-08:00). Note that 1/100 time resolution should be used.
leakagecurrent	number	No	Read Only	The leakage current in mA.
arraycurrent	number	Yes	Read Only	Output current of array in Amperes (A).
ratedarraycurrent	number	Yes	Read Only	Rated current of array (Nominal values of maximum power current * number of modules) (A), defined at manufacturing time.
if	array: see schema	No	Read Only	The OCF Interface set supported by this Resource.

#### 1.4.6 CRUDN behaviour

<Table Reference Here> defines the CRUDN operations that are supported on the "oic.r.pvconnectionterminal" Resource Type.

**Table 8 – The CRUDN operations of the Resource with type "rt" = "oic.r.pvconnectionterminal".**

Create	Read	Update	Delete	Notify
	get			observe