

**Environmental Engineering (EE);
Monitoring and Control Interface for Infrastructure Equipment
(Power, Cooling and Building Environment Systems used in
Telecommunication Networks);
Part 3: AC UPS power system control and
monitoring information model**



Reference

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ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
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Foreword

This ETSI Standard (ES) has been produced by ETSI Technical Committee Environmental Engineering (EE), and is now submitted for the ETSI standards Membership Approval Procedure.

The present document is part 3 of a multi-part deliverable covering Monitoring and Control Interface for Infrastructure Equipment (Power, Cooling and Building Environment Systems used in Telecommunication Networks), as identified below:

- Part 1: "Generic Interface";
- Part 2: "DC power system control and monitoring information model";
- Part 3: "AC UPS power system control and monitoring information model";**
- Part 4: "AC distribution power system control and monitoring information model";
- Part 5: "AC diesel back-up generator system control and monitoring information model";
- Part 6: "Air conditioning system control and monitoring information model";
- Part 7: "Other utilities system control and monitoring information model";
- Part 8: "Remote Power Feeding System control and monitoring information model".

1 Scope

The present document applies to monitoring and control of AC UPS power systems for telecommunication equipment.

The document defines :

- The monitored and controlled AC UPS power system architectures.
- The minimum set of exchanged information required at the interface, described in "natural language" in text tables.
- The XML files with tags and variables corresponding to the data in the tables.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific.

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 - for informative references.

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2.1 Normative references

The following referenced documents are indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

- [1] ETSI ES 202 336-1: "Environmental Engineering (EE); Monitoring and Control Interface for Infrastructure Equipment (Power, Cooling and Building Environment Systems used in Telecommunication Networks) Part 1: Generic Interface".
- [2] ETSI EN 300 132-3: "Environmental Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 3: Operated by rectified current source, alternating current source or direct current source up to 400 V".

2.2 Informative references

The following referenced documents are not essential to the use of the present document but they assist the user with regard to a particular subject area. For non-specific references, the latest version of the referenced document (including any amendments) applies.

- [i.1] IEEE 802.1 to 802.11: "IEEE Standard for Local & Metropolitan Area Network".
- [i.2] ISO/IEC 10164: " Information technology -- Open Systems Interconnection -- Systems Management: Objects and attributes for access control".

- [i.3] ISO/IEC 8879: " Information processing -- Text and office systems -- Standard Generalized Markup Language (SGML)".
- [i.4] ETSI EN 300 132-2: "Environmental Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 2: Operated by direct current (dc)".
- [i.5] ETSI EN 302 099: "Environmental Engineering (EE); Powering of equipment in access network".
- [i.6] ETSI TR 102 121: "Environmental Engineering (EE); Guidance for power distribution to telecommunication and datacom equipment".
- [i.7] ETSI ES 202 336-2: " Environmental Engineering (EE); Monitoring and Control Interface for Infrastructure Equipment (Power, Cooling and Building Environment Systems used in Telecommunication Networks); Part 2: DC power system control and monitoring information model".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

NOTE: Terms referring to energy interface, equipment and distribution are described in power distribution standards EN 300 132-2 [i.4], EN 300 132-3 [2] for ac and dc interface and EN 302 099 [i.5] for access network equipment powering.

alarm: any information signalling abnormal state, i.e. different to specified normal state of hardware, software, environment condition (temperature, humidity, etc.)

NOTE: The alarm signal should be understood by itself by an operator and should always have at least one severity qualification or codification (colour, level, etc.).

EXAMPLE: Rectifier failure, battery low volage, etc.

alarm loop: electrical loop which open or closed state correspond to alarm start (set) or end (clear) state

alarm message: text parts of the alarm structure

alarm structure: organized set of information fields in an alarm data frame (time stamp, set/clear, text, etc.)

battery: complete arrangement of battery cells or blocks in one string or more in parallel

battery cell: basic electrochemical element (e.g. a 2 V nominal cell for a high capacity lead acid battery)

battery string: a number of serially interconnected battery blocks or cells

client post: any device (laptop, PDA, console, etc.) connected to servers via the operation system networks to perform maintenance or supervision operations

Control form Style Sheet (CSS): simple mechanism for adding style (e.g. fonts, colors, spacing) to Web documents. Tutorials, books, mailing lists for users, etc.

Control Unit (CU): integrated unit in an equipment to monitor and control this equipment through sensors and actuators

Data Gathering Unit (DGU): functional unit used for several functions:

- collect serial, digital, and analog data from several equipment;
- option to send (output) serial or digital commands;
- forward/receive information to/from the Local/Remote Management Application via agreed protocols;
- mediation between interfaces and protocols.

NOTE: This function may be integrated as part of specific equipment.

Dynamic Host Control Protocol (DHCP): protocol used for self configuration of TCP/IP parameters of a workstation assigning IP address and a subnetwork mask

NOTE: DHCP may also configure DNS.

Dynamic Name Server (DNS): associates a single domain name to an IP address

dynamic synoptic: dynamic display of geographical maps, networks, installations and equipment

ethernet: LAN protocol

NOTE: Equivalent to IEEE 802.1 to IEEE 802.11 [i.1].

event: any information signalling a change of state which is not an alarm: e.g. battery test, change of state of battery charge

NOTE: The event signal should be understood by itself by an operator and should always have at least one severity qualification or codification (color, level, etc.). It should be transmitted in a formatted structure with text message and other fields like for alarm, e.g. an event can be coded as an alarm with severity "0".

eXtensible Style sheet Language (XSL): language for expressing style sheets

NOTE: It consists of two parts, a language for transforming XML documents, and an XML vocabulary for specifying formatting semantics. An XSL style sheet specifies the presentation of a class of XML documents by describing how an instance of the class is transformed into an XML document that uses the formatting vocabulary.

infrastructure equipment: power, cooling and building environment systems used in telecommunications centres and Access Networks locations

EXAMPLE: Cabinets, shelters, underground locations, etc.

intranet: internal company network generally using Ethernet protocol and extended IP addresses

logbook: chronological file that contains alarm and event messages may be paper or electronic

Management Information Base (MIB): dynamic data base that gathers all objects and should evolve to include automatic and manual configuration tools with self coherence tests

menu: list of possible input command choices that may be presented in different ways on a display

NOTE: Selection is normally made by a keyboard, a pointing device, a mouse or directly by finger on a sensitive screen.

object: class description of items that accept a set of properties or functions

NOTE: Generic objects can include more specific items and inherit from their properties. If correctly structured, object programming can allow the system to evolve, i.e. be more future-proof. The code should intrinsically be open and structured.

PHP: powerful tool for making dynamic and interactive Web pages

pop-up: information or command screen that appears when a menu choice is selected

NOTE: For example this may be a pop-up menu when the pointer is on a title button.

REpresentational State Transfer (REST): way to build an application for distributed system as www

Simple Object Access Protocol (SOAP): way to communicate between applications running on different operating systems, with different technologies and programming languages

NOTE: SOAP communicates over HTTP, because HTTP is supported by all Internet browsers and servers, SOAP traffic is not blocked by firewalls and proxy servers (see W3C).

Systems Management Function (SMF): object properties or classes with projection on CMIS application context communication

NOTE: Set of ISO system management functions according to ISO/IEC 10164 [i.2].

Uninterruptible Power Supply (UPS): device or system that provides electrical power without interruption in the event that commercial power drops to an unacceptable voltage level

warning: low severity alarm

web: common name for the Internet or Intranet

windows: virtual area on the display that corresponds to a specific application

World Wide Web Consortium (W3C): consortium founded in October 1994 to develop common interoperable protocols and promote World Wide Web

NOTE: See <http://www.w3c.org>.

XCU: CU enabled to communicate using XML interface as defined in the present document

XHTML: stricter and cleaner version of HTML. XHTML consists of all the elements in HTML 4.01 combined with the syntax of XML. It can be read by all XML browser (see W3C)

eXtensible Mark-up Language (XML): application profile or restricted form of SGML

NOTE: By construction, XML documents are conforming SGML the Standard Generalized Markup Language (ISO/IEC 8879 [i.3]). documents.XML is designed to describe data and focus on what data is. XML should be discerned from the well known Hypertext Transfer Mark-up Language (HTML) which was designed to display data and to focus on how data looks.

XML Schema Definition (XSD): new more detailed XML description compared to the previous one, the DTD

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AC	Alternating Current
CU	Control Unit of an equipment
CSS	Control form Style Sheet
DC	Direct Current
DGU	Data Gathering Unit
DHCP	Dynamic Host Control Protocol
DNS	Dynamic Name Server
HTML	Hypertex Transfer Make-up Language
HTTP	HyperTex Transfer Protocol
IP	Internet Protocol
LAN	Local Array Network
LVD	Low Voltage Disconnection
MIB	Mnagement Information Base
MN	Management Network
REST	REpresentational State Transfer
RMA	Remote Management Application
SBS	Static Bypass Switch
SMF	Systems Management Function
SOAP	Simple Object Access Protocol

TCP	Transmission Control Protocol for IP
UPS	Uninterruptible Power Supply
W3C	World Wide Web Consortium
XCU	XML enabled CU
XML	eXtensible Mark-up Language (see W3C)
XSD	XML Schema Definition
XSL	eXtensible Style sheet Language

4 AC UPS power systems

The AC UPS power systems subset described in ES 202 336-1 [1] and TR 102 121 [i.6] provides electrical power without interruption in the event that commercial power drops to an unacceptable voltage level.

The AC UPS power system provide uninterruptible 230V/400V; 50 Hz voltage according EN 300 132-3 [2], in period defined by capacity of installed back-up battery.

The AC UPS power systems addressed by the present document can be single phase input/single phase output, three phases input/single phase output and three phases input/three phases output.

The following configurations of static AC UPS power system will be under the scope of the present document: On-line AC UPS, Modular On-line AC UPS, Off-line AC UPS and Line-interactive AC UPS, which are depicted in figures 1 to figure 4.

In the case of paralleled AC UPS systems there can be an additional control unit (device) which controls parallel operation of the AC UPS systems. Parallel operation of UPS systems is outside the scope of the present document.

Mandatory and non-mandatory monitoring/supervision information and functions for On-line AC UPS and Modular On-line AC UPS are given in annex A.

Mandatory and non-mandatory monitoring/supervision information and functions for Off-line AC UPS are given in annex B.

Mandatory and non-mandatory monitoring/supervision information and functions for Line-interactive AC UPS are given in annex C.

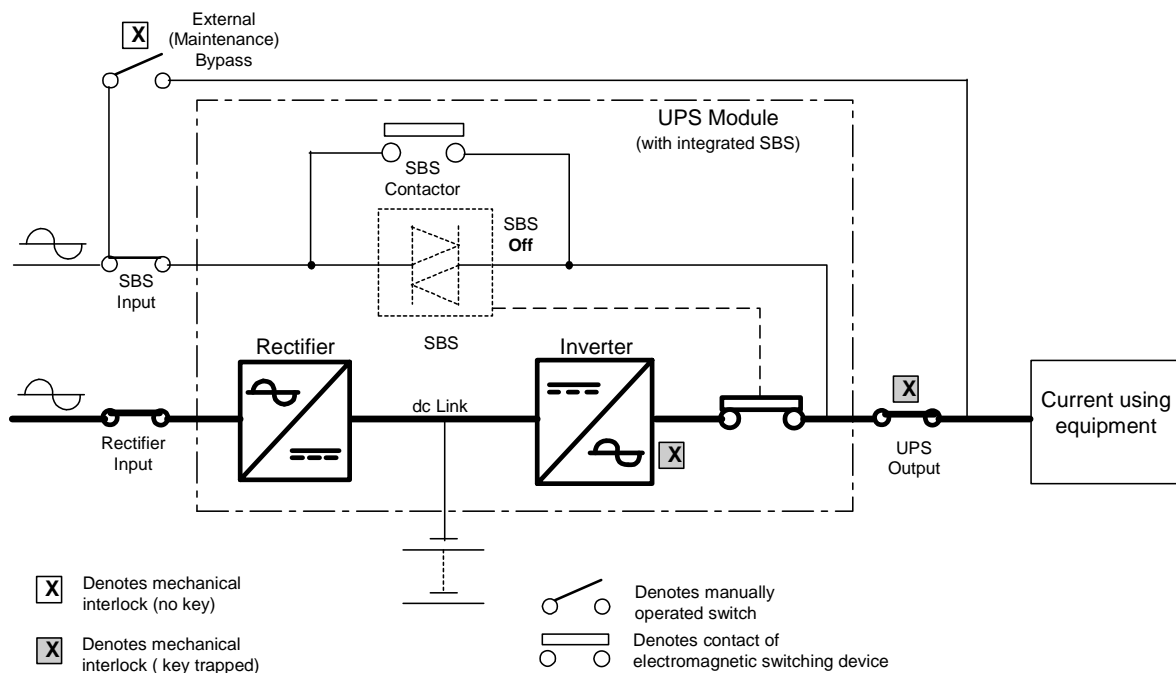


Figure 1: On-line AC UPS - normal operation

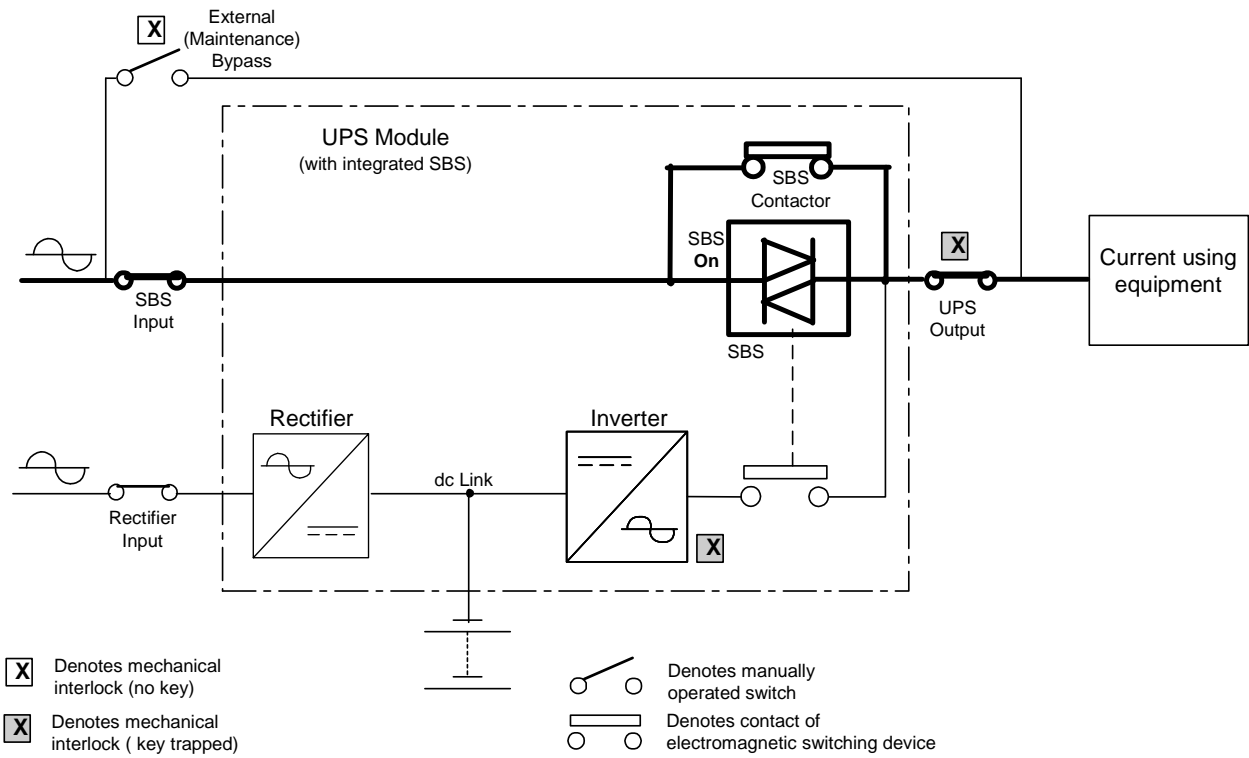
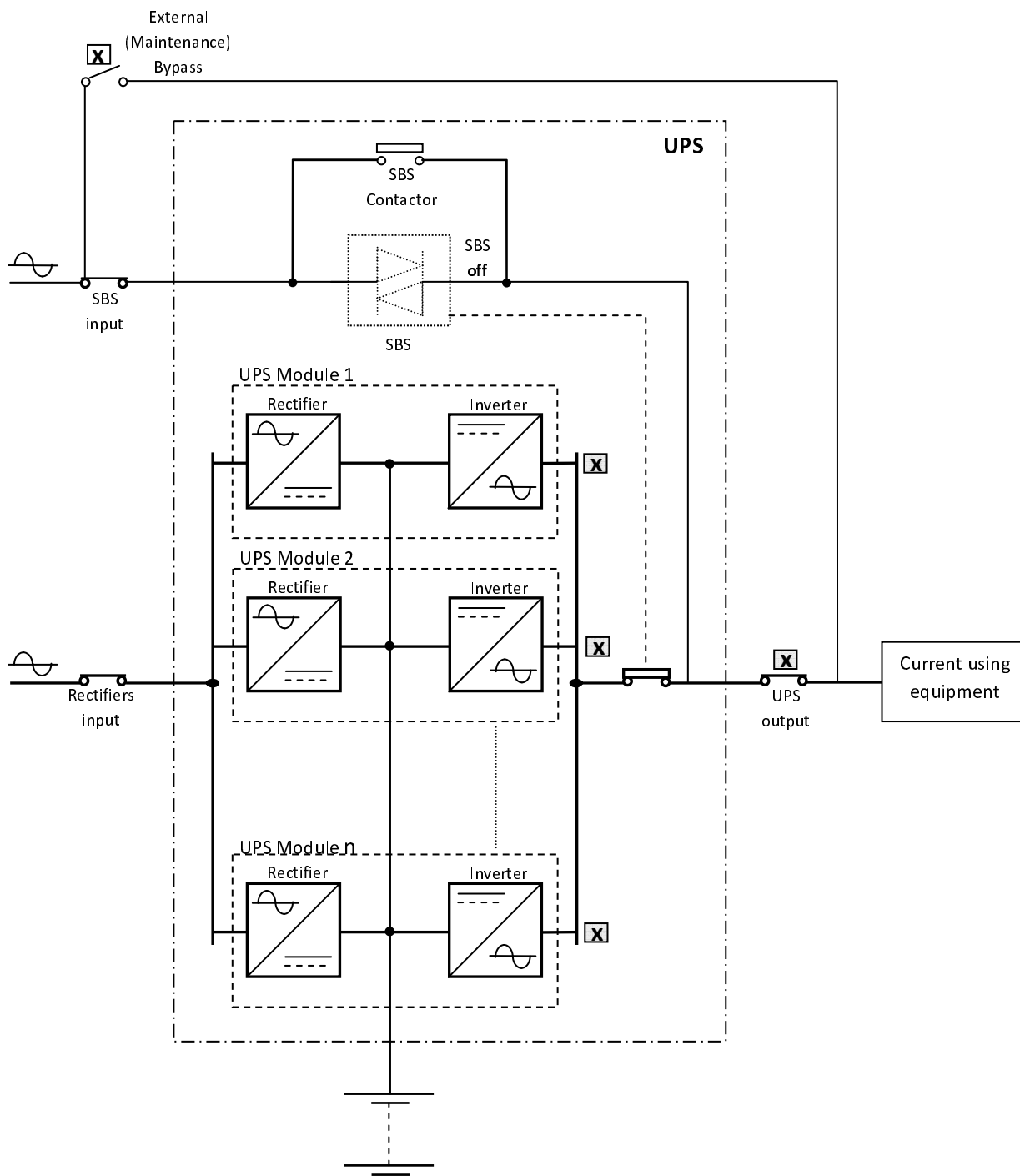




Figure 2: Off-line AC UPS - normal operation

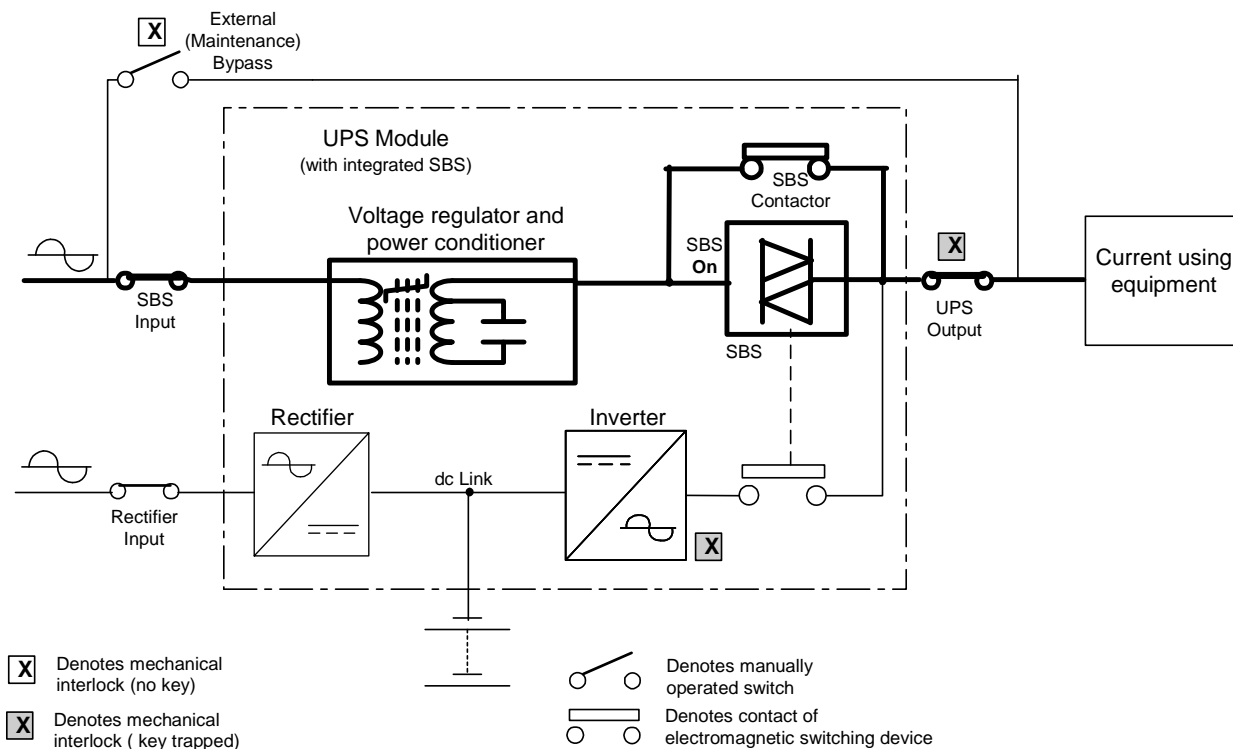


- | | |
|--|---|
| <input checked="" type="checkbox"/> Denotes mechanical Interlock (no key) |  Denotes manually operated switch |
| <input checked="" type="checkbox"/> Denotes mechanical Interlock (key trapped) |  Denotes contact of electromagnetic switching device |

NOTE 1: Battery can be central, or each module can have own battery.

NOTE 2: SBS can be central, or each module can have own SBS.

Figure 3: Modular On-line AC UPS - normal operation



NOTE 1: Rectifier and inverter in operation. Inverter synchronized to mains supply but not carrying load current.

NOTE 2: Bold lines indicate the load current path.

Figure 4: Line-interactive AC UPS - normal operation

The main elements of AC UPS power systems are:

- rectifier that converts AC voltage to DC voltage (i.e. 230 VAC/400VAC to DC voltage),
- battery (one or more strings of cells) that stores energy and can power the loads when AC interrupts or rectifiers fail. There can be test and permanent battery monitoring systems to reduce the failure detection time and the MTTR,
- protection and distribution (DC bus, breaker, etc.) to power different user loads and discriminate faults,
- inverter that converts DC voltage to AC voltage (i.e. DC voltage to 230 VAC/400VAC),
- Static Bypass Switch (SBS) monitors output and input voltage (mains AC voltage) of UPS, and synchronizes UPS output voltage to the input voltage, or transfers the input voltage to the output to supply Current using equipment,
- External (Manual) Bypass that transfers input voltage to the output to supply Current using equipment, in the case of UPS failure, UPS service, maintenance, etc.,
- a system monitoring and control unit (XCU) to monitor voltage, current, power, temperature etc, extend alarms and provide system control functionality.

NOTE: In Modular On-line AC UPS power system, each module is consist of rectifier and inverter. Construction of the AC UPS module can be 1 phase input/1 phase output and 3 phases input/3 phases output. Modular On-line AC UPS power system can be 1 phase input/1 phase output, 3 phases input/1phases output and 3 phases input/3 phases output.

Several measurements are possible: UPS input parameters: voltages, current, frequency, power, power factor (PF) etc., UPS output parameters: voltages, current, frequency, power, power factor (PF) etc., battery parameters: voltage, current and temperature, etc.

Several controls are possible: to adjust rectifier voltage and battery current, to start a battery test procedure, to adjust output UPS voltage and frequency, etc.

5 Summary of possible alarms, events, data, data records, configuration and control with explanation for AC UPS power system

In table 1 are given possible alarms, events, data, data records, configuration and control with explanation for AC UPS power system.

The "Explanation" column provided in the following data tables has been used where necessary to further explain the statements in the "Monitored information" column. The "Element type" column gives the assigned name used in XML coding and the "Monitored information" column provides details of the condition or state being monitored. The identifiers used in the Type column of the following tables are described in ES 202 336-1 [1].

NOTE: There can be others alarm, event, data, data record, configuration and control for an AC UPS power system, but they are not under the scope of the present document.

Annex A standardizes alarms, events, data, data records, configuration and control for an On-line AC UPS. Table A.1 corresponds to mandatory and non-mandatory data that shall be provided for an On-line AC UPS and Modular On-line AC UPS in different configurations (1 phase input/1 phase output, 3 phases input/1 phase output and 3 phases input/3 phases output).

Annex B standardizes alarms, events, data, data records, configuration and control for a Off-line AC UPS. Table B.1 corresponds to mandatory and non-mandatory data that shall be provided for an Off-line AC UPS.

Annex C standardizes alarms, events, data, data records, configuration and control for Line-interactive AC UPS. Table C.1 corresponds to mandatory and non-mandatory data that shall be provided for a Line-interactive AC UPS.

Tables A.1, B.1 and C.1 will have the necessary information for specific AC UPS systems, such as: On-line, Modular On-line, Off-line and Line-interactive.

Each table summarizes mandatory (normative) and non-mandatory (informative) monitoring/supervision information and functions of different AC UPS power systems.

Annex D standardizes XML coding structures for these data.

Table 1: possible alarm, event, data, data record, configuration and control

Element type	Monitored information	Explanation
Description	Device description (hardware and software)	
alarm	Battery circuit protection	DC fuse or circuit breaker tripped or in open position
	Battery discharge (e.g. due to mains loss, mains out of limits or not enough UPS power)	
	Battery in charging mode	
	Battery in BOOST charging mode	Voltage level for fast battery charging, e.g. 2,35 V/cell
	Battery test failure	Battery failed to pass defined test criteria e.g. autonomy time, voltage threshold
	Battery replacement needed (based on time counters or specific conditions)	
	Battery over-temperature	Battery temperature exceeds high limit setting
	Float voltage out of limits (e.g. relative to temperature)	Output DC voltage from rectifier
	Low Voltage Disconnect open (active)	When there is a battery or load disconnecting device the alarm indicates the disconnection has occurred

Element type	Monitored information	Explanation
Description	Device description (hardware and software)	
	Low DC shutdown voltage (LVD)	Battery discharged to minimum permissible level
	Low DC warning voltage	Battery nearly discharged
	Earth leakage detection on high voltage battery	
	Earthing of one battery pole	in case any battery poles are not grounded
	Battery temperature out of limits (jar or ambient lead acid batteries)	
	Battery temperature sensor failure	This sensor is for example placed on the battery jar or close to the battery
	Unbalanced discharge branch current	
	Unbalanced charge branch current	
	Absence of input voltage or input voltage is out from limited values	
	Short circuit and overload at the output of UPS	
	Peak current limiter active	Peak current limiter activated and UPS switched to bypass operation
	Absence of output voltage or output voltage is out from limited values	
	Output frequency is out from limited values	
	Temperature of UPS is out of limit (internal UPS temperature out of limit)	UPS temperature exceeds high limit setting
	Static by-pass in normal operation	
	Failure on static by-pass	
	Bypass out of tolerance	Bypass input voltage outside tolerance
	Synchronization error	UPS unable to synchronize with input frequency
	Load is supplied from static by-pass	
	Load is supplied from manual by-pass	
	Signalization of proper work of UPS	
	Failure of UPS	
	Failure of rectifier	
	Failure of inverter	
	Signalization of proper work of UPS module	In Modular On-line AC UPS
	Failure of UPS module	In Modular On-line AC UPS
	Failure of rectifier in UPS module	In Modular On-line AC UPS
	Failure of inverter in UPS module	In Modular On-line AC UPS
	Output UPS circuit protection	AC fuse or circuit breaker tripped or in open position
	Forced cooling failure (fan failure)	In case of UPS forced cooling
	Forced cooling failure (fan failure) of specific UPS module	In Modular On-line AC UPS
event	Alarm set and clear (data log)	
	Details of any change of configuration and parameters of UPS	Change of parameter e.g. float voltage change, output voltage change...
	Change of UPS operating mode	Change of operation e.g. Boost charge , load supplied from static by-pass, battery test...
	Battery test execution report	
	Status change or fast repetition (charge-discharge event)	
	Indication of restart with back-up or customized parameters (auto-recovery in case of Control Unit reset or replacement)	
	power interconnection	

Element type	Monitored information	Explanation	
Description	Device description (hardware and software)		
data	Input phase AC voltage ($\pm 2V$)	Phases L1, L2, L3 for 3 phases input UPS	
	Input line AC voltage ($\pm 2V$)	Line L1-L2; L1-L3; L2-L3 for 3 phases input UPS	
	Input AC current ($\pm 2\%$)	Current in phases L1, L2 and L3 for 3 phases input UPS	
	Input AC current ($\pm 2\%$) of each UPS module	In Modular On-line AC UPS	
	Input frequency ($\pm 0,1$ Hz)		
	Input power factor		
	Input active power	In W	
	Input reactive power	In VAR	
	Total Input power	In VA. Can be calculated as $S = \sqrt{P^2 + Q^2}$	
	Total harmonic current distortion at the UPS input	In %, or in A per harmonics	
	Output phase AC voltage ($\pm 2V$)	Phases L1, L2, L3 for 3 phases output UPS	
	Output line AC voltage ($\pm 2V$)	Line L1-L2; L1-L3; L2-L3 for 3 phases output UPS	
	Output AC current ($\pm 2\%$)	Current in phases L1, L2 and L3 for 3 phases output UPS	
	Output AC current ($\pm 2\%$) of each UPS module	In Modular On-line AC UPS	
	Average value of AC output load current I_{AV} ($\pm 5\%$) over a preset time window		
	Output frequency ($\pm 0,1$ Hz)		
	Output power factor		
	Output active power	In W	
	Output reactive power	In VAR	
	Total output power	In VA. Can be calculated as $S = \sqrt{P^2 + Q^2}$	
	Total harmonic voltage distortion at the UPS output	In %, or in V per harmonics	
	Static by-pass current ($\pm 2\%$)		
	Internal UPS temperature ($\pm 1^\circ C$)	Measured at temperature critical place inside UPS e.g. on the heater with power components	
	Room temperature ($\pm 1^\circ C$)	Temperature in the room where the UPS is mounted	
	Battery temperature ($\pm 1^\circ C$)		
	Total Battery voltage ± 1 V - this precision is required for floating voltage derating detection and temperature charge compensation (around -3 mV/K/cell).	DC voltage at the rectifier output	
	Charge and discharge battery current I_{Batt} ($\pm 1\%$)		
	Battery branch current ($\pm 1\%$)		
	Estimated remaining battery autonomy (time) during discharge		
	Battery age since date of installation		
Estimated remaining battery capacity (due to ageing) at full charge ($\pm 5\%$)			
Power capacity management (ratio) = Used/Installed power			
Battery discharge alarm duration	Time period over which battery is discharging e.g. caused by actual mains supply failure or insufficient output power from rectifiers due to failure		
XCU program download with default to previous release			

Element type	Monitored information	Explanation
Description	Device description (hardware and software)	
data record	Battery temperature	Battery temperature data log at 1 hour interval limited to a defined number of records
	AC output current	Average current data log e.g. at 5 min interval limited to a defined number of records
	AC output voltage	Voltage record e.g. at 1 hour interval limited to a defined number of records
	Output frequency	Average frequency data log e.g. at 5 min interval limited to a defined number of records
	Detailed battery test data record : discharge chart, temperature, string current, cell voltages	
	Input (AC) energy consumption over preset period	
	AC output total power	This value can be calculated by the AC power system controller from AC output voltage and current measurements
config	Date and time	
	Sliding time window to capture maximum output AC current All XCU alarm/event/test/command parameters (time-out, counter, thresholds, etc.)	Period of time over which power data logging is carried out
	Range of frequency synchronization	Range of input frequency when the output and input frequency are the same (max $\pm 2,5$ Hz)
	Low DC shutdown voltage (LVD)	
	Low DC warning voltage	
	Battery capacity	
	Output low voltage threshold	
	Battery over-temperature threshold	
	Unbalanced charge branch current (persistent string branch charge current difference/mean string charge current value)	
	Unbalanced branch discharge current (persistent string branch discharge current difference/mean string discharge current value)	
	battery test parameters	
	Output overload threshold (consumed power/ useful power where useful power is installed power without redundancy or battery recharge power).	
Maximum battery charging current		
Battery charging voltage (boost, float voltage)		
Battery life expectancy at 20 °C (as provided by manufacturer)		
control	Any forced change of operating mode e.g. battery discharge test, boost charge	
	XCU program download with default to previous release	
	Default values resetting (safe value for XCU)	
	Battery test on demand	
	UPS power device control (rectifiers, inverter, static by-pass, Low Voltage Disconnection, etc.)	
	UPS module control	In Modular On-line AC UPS
	Acknowledge battery replacement	
	Acknowledge alarms	

Annex A (normative): Summary of mandatory and non-mandatory monitoring/supervision information and functions for On-line AC UPS power systems

This annex gathers the information needed on the Remote Management Application (RMA) for different types of On-Line and Modular On-line AC UPS power system. It specifies the mandatory and not-mandatory requirements that must be provided in all cases.

NOTE 1: These tables do not specify the power equipment by itself. These tables refer to subsets or devices that are not necessarily present in each equipment configuration. As a matter of fact, one alarm and its class apply only in case of the presence of this subset or device.

When an optional alarm that requires a parameter set is present, the corresponding parameter set is mandatory in the control section in order to allow remote adjustment under appropriate login procedure.

According to their element type (Description, Alarm, Data, etc.), as defined in ES 202 336-1 [1] the information shall be provided by the Control Unit (XCU).

NOTE 2: If there is no XCU this data should be provided by the Data Gathering Unit (DGU).

When a CU has a field databus connected to the DGU, at least, the DGU shall store data (record measurements, log files). The XCU which has the XML interface over Ethernet TCP/IP, shall store these data.

NOTE 3: Partial communication network failures e.g. XCU link fault should be detected by an upper element of the network e.g. the RMA (refer to figure 1 of ES 202 336-1 [1]).

NOTE 4: Clause 9.4.4 of ES 202 336-1 [1] details the parameters associated with XML elements e.g. time delay, severity of alarm element. The tables below do not include the application of these parameters.

NOTE 5: Table A.1 specifies mandatory and non-mandatory requirements for On-line and Modular On-line AC UPS power systems. **M** specified mandatory requirements and **NM** specified non-mandatory requirements. Blank fields means there is no requirements for specific type of AC UPS.

Table A.1

Element type	Monitored information	On line AC UPS (MONOLITE)			Modular On line AC UPS	
		1ph.in./1ph.out	3ph.in./1ph.out	3ph.in./3ph.out	1ph.in./1ph.out; 3ph.in./1ph.out	3ph.in./3ph.out
Description	Device description (hardware and software)					
alarm	Battery circuit protection	NM	NM	M	M	M
	Battery discharge (e.g. due to mains loss, mains out of limits or not enough UPS power)	M	M	M	M	M
	Battery in charging mode	NM	NM	M	M	M
	Battery in BOOST charging mode	NM	NM	NM	NM	NM
	Battery test failure	M	M	M	M	M
	Battery replacement needed (based on time counters or specific conditions)	NM	NM	M	M	M
	Battery over-temperature	MN	M	M	M	M
	Float voltage out of limits (e.g. relative to temperature)	NM	M	M	M	M
	Low Voltage Disconnect open (active)	NM	NM	M	M	M
	Low DC shutdown voltage (LVD)	M	M	M	M	M
	Low DC warning voltage	NM	NM	NM	NM	NM
	Earth leakage detection on high voltage battery	NM	NM	NM	NM	NM
Earthing of one battery pole	NM	NM	NM	NM	NM	

Element type	Monitored information	On line AC UPS (MONOLITE)			Modular On line AC UPS	
		1ph.in./1ph.out	3ph.in./1ph.out	3ph.in./3ph.out	1ph.in./1ph.out; 3ph.in./1ph.out	3ph.in./3ph.out
Description	Device description (hardware and software)					
	Battery temperature out of limits (jar or ambient lead acid batteries)	NM	NM	M	M	M
	Battery temperature sensor failure	NM	NM	M	NM	M
	Unbalanced discharge branch current	NM	NM	NM	NM	NM
	Unbalanced charge branch current	NM	NM	NM	NM	NM
	Absence of input voltage or input voltage is out from limited values	M	M	M	M	M
	Short circuit and overload at the output of UPS	M	M	M	M	M
	Peak current limiter active	NM	NM	NM	NM	NM
	Absence of output voltage or output voltage is out from limited values	M	M	M	M	M
	Output frequency is out from limited values	NM	M	M	M	M
	Temperature of UPS is out of limit (internal UPS temperature out of limit)	NM	NM	M	M	M
	Static by-pass is in normal operation	NM	NM	M	M	M
	Failure on static by-pass	NM	M	M	M	M
	Bypass out of tolerance	NM	M	M	M	M
	Synchronization error	NM	M	M	M	M
	Load is supplied from static by-pass	M	M	M	M	M
	Load is supplied from manual by-pass	NM	NM	M	M	M
	Signalization of proper work of UPS	M	M	M	M	M
	Failure of UPS	M	M	M	M	M
	Failure of rectifier	NM	NM	M		
	Failure of inverter	NM	NM	M		
	Signalization of proper work of UPS module				M	M
	Failure of UPS module				M	M
	Failure of rectifier in UPS module				NM	NM
	Failure of inverter in UPS module				NM	NM
	Output UPS circuit protection	NM	NM	M	M	M
Forced cooling failure (fan failure)	NM	NM	M	M	M	
Forced cooling failure (fan failure) of specific UPS module				NM	M	
event	Alarm set and clear (date log)	NM	M	M	M	M
	Details of any change of configuration and parameters of UPS	NM	M	M	M	M
	Change of UPS operating mode	NM	NM	M	M	M
	Battery test execution report	NM	NM	M	M	M
	Status change or fast repetition (charge-discharge event)	NM	NM	M	M	M
	Indication of restart with back-up or customized parameters (auto-recovery in case of Control Unit reset or replacement)	NM	NM	M	M	M
	Power interconnection	NM	NM	M	NM	M

Element type	Monitored information	On line AC UPS (MONOLITE)			Modular On line AC UPS	
		1ph.in./1ph.out	3ph.in./1ph.out	3ph.in./3ph.out	1ph.in./1ph.out; 3ph.in./1ph.out	3ph.in./3ph.out
Description	Device description (hardware and software)					
data	Input phase AC voltage (± 2 V)	NM	M	M	M	M
	Input line AC voltage (± 2 V)		M	M	NM	M
	Input AC current (± 2 %)	NM	NM	M	NM	M
	Input AC current (± 2 %) of each UPS module				NM	NM
	Input frequency ($\pm 0,1$ Hz)	NM	NM	M	M	M
	Input power factor	NM	NM	NM	NM	NM
	Input active power	NM	NM	NM	NM	NM
	Input reactive power	NM	NM	NM	NM	NM
	Total Input power	NM	NM	M	M	M
	Total harmonic current distortion at the UPS input	NM	NM	NM	NM	NM
	Output phase AC voltage (± 2 V)	NM	M	M	M	M
	Output line AC voltage (± 2 V)			M		M
	Output AC current (± 2 %)	NM	M	M	M	M
	Output AC current (± 2 %) of each UPS module				M	M
	Average value of AC output load current I_{Av} (± 5 %) over a preset time window	NM	NM	NM	NM	NM
	Output frequency ($\pm 0,1$ Hz)	NM	M	M	M	M
	Output power factor	NM	NM	M	NM	M
	Output active power	NM	NM	M	NM	M
	Output reactive power	NM	NM	NM	NM	NM
	Output power	NM	M	M	M	M
	Total harmonic voltage distortion at the UPS output	NM	NM	NM	NM	NM
	Static by-pass current (± 2 %)	NM	NM	M	NM	M
	Internal UPS temperature (± 1 °C)	NM	M	M	M	M
	Room temperature (± 1 °C)	NM	NM	NM	NM	NM
	Battery temperature (± 1 °C)	NM	NM	M	NM	M
	Total Battery voltage (± 1 V) - this precision is required for floating voltage derating detection and temperature charge compensation (around -3 mV/K/cell).	NM	M	M	M	M
	Charge and discharge battery current I_{Batt} (± 1 %)	NM	M	M	M	M
	Battery branch current (± 1 %)	NM	NM	NM	NM	NM
Estimated remaining battery autonomy (time) during discharge	NM	NM	M	M	M	
Battery age since date of installation	NM	NM	NM	NM	NM	
Estimated remaining battery capacity (due to ageing) at full charge (± 5 %)	NM	NM	M	NM	M	
Power capacity management (ratio) = Used/Installed power	NM	NM	NM	NM	NM	
Battery discharge alarm duration	NM	NM	M	NM	M	
XCU program download with default to previous release	NM	NM	M	NM	M	
data record	Battery temperature	NM	NM	M	M	M
	AC output current	NM	NM	M	M	M
	AC output voltage	NM	NM	M	M	M
	Output frequency	NM	NM	M	M	M
	Detailed battery test data record : discharge chart, temperature, string current, cell voltages	NM	NM	NM	NM	NM
	Input (AC) energy consumption over preset period	NM	NM	NM	NM	NM
	AC output total power	NM	NM	M	M	M

Element type	Monitored information	On line AC UPS (MONOLITE)			Modular On line AC UPS	
		1ph.in./1ph.out	3ph.in./1ph.out	3ph.in./3ph.out	1ph.in./1ph.out; 3ph.in./1ph.out	3ph.in./3ph.out
Description	Device description (hardware and software)					
config	Date and time	M	M	M	M	M
	Sliding time window to capture maximum output AC current					
	All XCU alarm/event/test/command parameters (time-out, counter, thresholds, etc.)	NM	NM	M	NM	M
	Range of frequency synchronization	NM	NM	M	M	M
	Low DC shutdown voltage	M	M	M	M	M
	Low DC warning voltage	NM	NM	NM	NM	NM
	Battery capacity	NM	NM	M	M	M
	Output low voltage threshold	NM	M	M	M	M
	Battery over-temperature threshold	NM	NM	M	M	M
	Unbalanced charge branch current (persistent string branch charge current difference/mean string charge current value)	NM	NM	NM	NM	NM
	Unbalanced branch discharge current (persistent string branch discharge current difference/mean string discharge current value)	NM	NM	NM	NM	NM
	battery test parameters	NM	NM	M	NM	M
	Output overload threshold (consumed power/ useful power where useful power is installed power without redundancy or battery recharge power)	NM	NM	NM	NM	NM
Maximum battery charging current	NM	M	M	M	M	
Battery charging voltage (boost, float voltage)	NM	NM	M	M	M	
Battery life expectancy at 20 °C (as provided by battery manufacturer)	NM	NM	NM	NM	NM	
control	Any forced change of operating mode e.g. battery discharge test, boost charge	NM	NM	M	M	M
	XCU program download with default to previous release	NM	NM	M	M	M
	Default values resetting (safe value for XCU)	NM	M	M	M	M
	Battery test on demand	NM	NM	M	M	M
	UPS power device control (rectifiers, inverter, static by-pass, Low Voltage Disconnection, etc)	NM	NM	M	M	M
	UPS module control				M	M
	Acknowledge battery replacement	NM	NM	M	M	M
Acknowledge alarms	NM	NM	NM	NM	NM	

Annex B (normative): Summary of mandatory and non-mandatory monitoring/supervision information and functions for Off-line AC UPS power systems

This annex gathers the information needed on the Remote Management Application (RMA) for Off-Line AC UPS power system. It specifies the mandatory and not-mandatory requirements that must be provided in all cases.

NOTE 1: These tables do not specify the power equipment by itself. These tables refer to subsets or devices that are not necessarily present in each equipment configuration. As a matter of fact, one alarm and its class apply only in case of the presence of this subset or device.

When an optional alarm that requires a parameter set is present, the corresponding parameter set is mandatory in the control section in order to allow remote adjustment under appropriate login procedure.

According to their element type (Description, Alarm, Data, etc.), as defined in ES 202 336-1 [1] the information shall be provided by the Control Unit (XCU).

NOTE 2: If there is no XCU this data should be provided by the Data Gathering Unit (DGU).

When a CU has a field databus connected to the DGU, at least, the DGU shall store data (record measurements, log files). The XCU which has the XML interface over Ethernet TCP/IP, shall store these data.

NOTE 3: Partial communication network failures e.g. XCU link fault should be detected by an upper element of the network e.g. the RMA (refer to figure 1 of ES 202 336-1 [1]).

NOTE 4: Clause 9.4.4 of ES 202 336-1 [1] details the parameters associated with XML elements e.g. time delay, severity of alarm element. The tables below do not include the application of these parameters.

NOTE 5: Table B.1 specifies mandatory and non-mandatory requirements for Off-line AC UPS power systems. **M** specified mandatory requirements and **NM** specified non-mandatory requirements. Blank fields means there is no requirements for specific type of UPS.

Table B.1

Element type	Monitored information	Off-line AC UPS
Description	Device description (hardware and software)	
alarm	Battery circuit protection	NM
	Battery discharge (e.g. due to mains loss, mains out of limits or not enough UPS power)	M
	Battery in charging mode	M
	Battery in BOOST charging mode	NM
	Battery test failure	NM
	Battery replacement needed (based on time counters or specific conditions)	NM
	Battery over-temperature	NM
	Float voltage out of limits (e.g. relative to temperature)	NM
	Low Voltage Disconnect open (active)	NM
	Low DC shutdown voltage(LVD)	M
	Low DC warning voltage	NM
	Earth leakage detection on high voltage battery	NM
	Earthing of one battery pole	NM
	Battery temperature out of limits (jar or ambient lead acid batteries)	M
	Battery temperature sensor failure	NM
Unbalanced discharge branch current	NM	
Unbalanced charge branch current	NM	

Element type	Monitored information	Off-line AC UPS
Description	Device description (hardware and software)	
	Absence of input voltage or input voltage is out from limited values	M
	Short circuit and overload at the output of UPS	NM
	Absence of output voltage or output voltage is out from limited values	M
	Output frequency is out from limited values	M
	Temperature of UPS is out of limit (internal UPS temperature out of limit)	NM
	Static by-pass is in normal operation	NM
	Failure on static by-pass	NM
	Load is supplied from static by-pass (normal working operation)	NM
	Load is supplied from inverter	NM
	Load is supplied from manual by-pass	NM
	Signalization of proper work of UPS	M
	Failure of UPS	M
	Failure of rectifier	NM
	Failure of inverter	NM
	Output UPS circuit protection	NM
Forced cooling failure (fan failure)	NM	
event	Alarm set and clear (data log)	M
	Details of any change of configuration and parameters of UPS	M
	Change of UPS operating mode	M
	Battery test execution report	NM
	Status change or fast repetition (charge-discharge event)	NM
	Indication of restart with back-up or customized parameters (auto-recovery in case of Control Unit reset or replacement)	NM
data	power interconnection	NM
	Input phase AC voltage (± 2 V)	M
	Input line AC voltage (± 2 V)	NM
	Input AC current (± 2 %)	M
	Input frequency ($\pm 0,1$ Hz)	M
	Input power factor	NM
	Input active power	NM
	Input reactive power	NM
	Total Input power	NM
	Total harmonic current distortion at the UPS input	NM
	output phase AC voltage (± 1 V)	M
	output line AC voltage (± 1 V)	NM
	output AC current (± 2 %)	M
	Average value of AC output load current I_{AV} (± 5 %) over a preset time window	NM
	Output frequency ($\pm 0,1$ Hz)	M
	Output power factor	NM
	Output active power	NM
	Output reactive power	NM
	Total Output power	NM
	Total harmonic voltage distortion at the UPS output	NM
	Static by-pass current (± 2 %)	NM
	Internal UPS temperature (± 1 °C)	NM
	Room temperature (± 1 °C)	NM
	Battery temperature (± 1 °C)	NM
	Total Battery voltage ± 1 V - this precision is required for floating voltage derating detection and temperature charge compensation (around -3 mV/K/cell).	M
	Charge and discharge battery current I_{Batt} (± 1 %)	M
	Battery string current (± 1 %)	NM
	Estimated remaining battery autonomy (time) during discharge	NM
	Battery age since date of installation	NM
	Estimated remaining battery capacity (due to ageing) at full charge (± 5 %)	NM
Power capacity management (ratio) = Used/Installed power	NM	
Battery discharge alarm duration	NM	
XCU program download with default to previous release	NM	

Element type	Monitored information	Off-line AC UPS
Description	Device description (hardware and software)	
data record	Battery temperature	NM
	AC output current	NM
	AC output voltage	NM
	Output frequency	NM
	Detailed battery test data record: discharge chart, temperature, string current, cell voltages	NM
	Input (AC) energy consumption over preset period	NM
	AC output power	NM
config	Date and time	M
	Sliding time window to capture maximum output AC current	
	All XCU alarm/event/test/command parameters (time-out, counter, thresholds, etc.)	NM
	Low DC shutdown voltage	M
	Low DC warning voltage	NM
	Battery capacity	NM
	Output low voltage threshold	NM
	Battery over-temperature threshold	NM
	Unbalanced charge branch current (persistent string branch charge current difference/mean string charge current value)	NM
	Unbalanced branchdischarge current (persistent string branch discharge current difference/mean string discharge current value)	NM
	battery test parameters	NM
	Output overload threshold (consumed power/useful power where useful power is installed power without redundancy or battery recharge power)	NM
Maximum battery charging current	M	
Battery charging voltage	NM	
Battery life expectancy at 20 °C (as provided by manufacturer)	NM	
control	Any forced change of operating mode e.g. battery discharge test, boost charge	M
	XCU program download with default to previous release	M
	Default values resetting (safe value for XCU)	M
	Battery test on demand	NM
	UPS power device control (rectifiers, inverter, static by-pass, Low Voltage Disconnection, etc.)	NM
	Acknowledge battery replacement	NM
	Acknowledge alarms	NM

Annex C (normative): Summary of mandatory and non-mandatory monitoring/supervision information and functions for Line-interactive AC UPS power systems

This annex gathers the information needed on the Remote Management Application (RMA) for different types of Line-interactive AC UPS power system. It specifies the mandatory and not-mandatory requirements that must be provided in all cases.

NOTE 1: These tables do not specify the power equipment by itself. These tables refer to subsets or devices that are not necessarily present in each equipment configuration. As a matter of fact, one alarm and its class apply only in case of the presence of this subset or device.

When an optional alarm that requires a parameter set is present, the corresponding parameter set is mandatory in the control section in order to allow remote adjustment under appropriate login procedure.

According to their element type (Description, Alarm, Data, etc.), as defined in ES 202 336-1 [1] the information shall be provided by the Control Unit (XCU).

NOTE 2: If there is no XCU this data should be provided by the Data Gathering Unit (DGU).

When a CU has a field databus connected to the DGU, at least, the DGU shall store data (record measurements, log files). The XCU which has the XML interface over Ethernet TCP/IP, shall store these data.

NOTE 3: Partial communication network failures e.g. XCU link fault should be detected by an upper element of the network e.g. the RMA (refer to figure 1 of ES 202 336-1 [1]).

NOTE 4: Clause 9.4.4 of ES 202 336-1 [1] details the parameters associated with XML elements e.g. time delay, severity of alarm element. The tables below do not include the application of these parameters.

NOTE 5: Table C.1 specifies mandatory and non-mandatory requirements for Line-interactive AC UPS power systems. **M** specified mandatory requirements and **NM** specified non-mandatory requirements. Blank fields means there is no requirements for specific type of UPS.

Table C.1

Element type	Monitored information	Lline-interactive AC UPS	
Description	Device description (hardware and software)		
alarm	Battery circuit protection	M	
	Battery discharge (e.g. due to mains loss, mains out of limits or not enough UPS power)	M	
	Battery in charging mode	M	
	Battery in BOOST charging mode	NM	
	Battery test failure	NM	
	Battery replacement needed (based on time counters or specific conditions)	NM	
	Battery over-temperature	M	
	Float voltage out of limits (e.g. relative to temperature)	M	
	Low Voltage Disconnect open (active)	M	
	Low DC shutdown voltage	M	
	Low DC warning voltage	NM	
	Earth leakage detection on high voltage battery	NM	
	Earthing of one battery pole	NM	
	Battery temperature out of limits (jar or ambient lead acid batteries)	NM	
	Battery temperature sensor failure	NM	
	Unbalanced discharge branch current	NM	
	Unbalanced charge branch current	NM	
	Absence of input voltage or input voltage is out from limited values	M	
	Short circuit and overload at the output of UPS	NM	
	Absence of output voltage or output voltage is out from limited values	M	
	Output frequency is out from limited values	M	
	Temperature of UPS is out of limit Internal UPS temperature out of limit)	M	
	Static by-pass is in normal operation	NM	
	Failure on static by-pass	NM	
	Synchronization error	NM	
	Load is supplied from static by-pass (normal working operation)	M	
	Load is supplied from inverter	M	
	Load is supplied from manual by-pass	NM	
	Signalization of proper work of UPS	M	
Failure of UPS	M		
Failure of rectifier	NM		
Failure of inverter	NM		
Output UPS circuit protection	M		
Forced cooling failure (fan failure)	M		
event	Alarm set and clear (data log)	M	
	Details of any change of configuration and parameters of UPS	M	
	Change of UPS operating mode	M	
	Battery test execution report	NM	
	Status change or fast repetition (charge-discharge event)	NM	
	Indication of restart with back-up or customized parameters (auto-recovery in case of Control Unit reset or replacement)	NM	
	power interconnection	NM	

Element type	Monitored information	Lline-interactive AC UPS	
Description	Device description (hardware and software)		
data	Input phase AC voltage (± 2 V)	M	
	Input line AC voltage (± 2 V)	NM	
	Input AC current (± 2 %)	M	
	Input frequency ($\pm 0,1$ Hz)	M	
	Input power factor	NM	
	Input active power	NM	
	Input reactive power	NM	
	Total Input power	NM	
	Total harmonic current distortion at the UPS input	NM	
	Output phase AC voltage (± 2 V)	M	
	Output line AC voltage (± 2 V)	NM	
	Output AC current (± 2 %)	M	
	Average value of AC output load current I_{AV} (± 5 %) over a preset time window	NM	
	Output frequency ($\pm 0,1$ Hz)	M	
	Output power factor	NM	
	Output active power	NM	
	Output reactive power	NM	
	Total Output power	M	
	Total harmonic voltage distortion at the UPS output	NM	
	Static by-pass current (± 2 %)	NM	
	Internal UPS temperature ($\pm 1^{\circ}\text{C}$)	M	
	Room temperature ($\pm 1^{\circ}\text{C}$)	NM	
	Battery temperature ($\pm 1^{\circ}\text{C}$)	M	
	Total Battery voltage ± 1 V - this precision is required for floating voltage derating detection and temperature charge compensation (around -3 mV/K/cell)	M	
	Charge and discharge battery current I_{Batt} ($\pm 1\%$)	M	
	Battery branch current ($\pm 1\%$)	NM	
	Estimated remaining battery autonomy (time) during discharge	NM	
	Battery age since date of installation	NM	
	Estimated remaining battery capacity (due to ageing) at full charge (± 5 %)	NM	
Power capacity management (ratio) = Used/Installed power	NM		
Battery discharge alarm duration	NM		
XCU program download with default to previous release	NM		
data record	Battery temperature	NM	
	AC output current	M	
	AC output voltage	M	
	Output frequency	M	
	Detailed battery test data record: discharge chart, temperature, string current, cell voltages	NM	
	Input (AC) energy consumption over preset period	NM	
	AC output power	NM	

Element type	Monitored information	Lline-interactive AC UPS
Description	Device description (hardware and software)	
config	Date and time	M
	Sliding time window to capture maximum output AC current	
	All XCU alarm/event/test/command parameters (time-out,counter,thresholds, etc.)	M
	Low DC shutdown voltage (LVD)	M
	Low DC warning voltage	NM
	Battery capacity	M
	Output low voltage threshold	M
	Battery over-temperature threshold	NM
	Unbalanced charge branch current (persistent string branch charge current difference/mean string charge current value)	NM
	Unbalanced branch discharge current (persistent string branch discharge current difference/mean string discharge current value)	NM
	battery test parameters	NM
	Output overload threshold (consumed power/useful power where useful power is installed power without redundancy or battery recharge power)	NM
Maximum battery charging current	M	
Battery charging voltage (boost, float voltage)	NM	
Battery life expectancy at 20 °C (as provided by manufacturer)	NM	
control	Any forced change of operating mode e.g. battery discharge test, boost charge	M
	XCU program download with default to previous release	M
	Default values resetting (safe value for XCU)	M
	Battery test on demand	NM
	UPS power device control (rectifiers, inverter, static by-pass, Low Voltage Disconnection, etc.)	NM
	Acknowledge battery replacement	NM
	Acknowledge alarms	NM

Annex D (normative): Mandatory XML structure and elements

D.1 Structure of an XML document for a AC UPS power system

In the site DGU XML data structure as described in ES 202 336-1 [1].

The XML structure shall be as follows:

NOTE: Indicate precisely the generic mandatory XML structure and where to put the information if it exists (where it starts and stops). Every equipment and element, should be considered as a folder in the XML structure.

```
<site id="23" status="normal">
  ....
  <energy_system id="1" status="normal">
    <description_table>
      ...
    </description_table>
    ...
    <ac_ups_system id="1" status="normal">
      <description_table>
        ...
      </description_table>
      <alarm_table>
        ...
      </alarm_table>
      <event_table>
        ...
      </event_table>
      <data_table>
        ...
      </data_table>
      <data_record_table>
        ...
      </data_record_table>
      <config_table>
        ...
      </config_table>
      <control_table>
        ...
      </control_table>
    ...
  </ac_ups_system>
  ...
</energy_system>
</site>
```

An AC UPS power system XCU will only generate the XML document "ac_ups_system.xml". This file can be downloaded by the DGU of the site and embedded in the "site.xml" document. In this case, the structure of the document is as follows:

```
<ac_ups_system id="1" status="normal">
  <description_table>
  ...
  </description_table>
  <alarm_table>
  ...
  </alarm_table>
  <event_table>
  ...
  </event_table>
  <data_table>
  ...
  </data_table>
  <data_record_table>
  ...
  </data_record_table>
  <config_table>
  ...
  </config_table>
  <control_table>
  ...
  </control_table>
  ...
</ac_ups_system>
```

D.2 The specific XML elements of an AC UPS power system

Here follows the specific tags for XML elements that are not detailed in ES 202 336-1 [1].

As "AC UPS System" can be very complex, the manufacturer is free to add sub-equipments in the XML structure to provide more detailed information, data, control, etc.

The allowed child elements of <ac_ups_system> are:

Table D.1

Child Element	Description	Datatype
<rectifier>	For detailed information about rectifier (or rectifier in UPS module). This equipment is already described in ES 202 336-2 [i.7] about DC Systems	xs:complexType
<inverter>	For detailed information about inverter (or inverterer in UPS module)	xs:complexType
<static_bypass_switch>	For detailed information about SBS	xs:complexType
<battery>	For detailed information about the battery	xs:complexType
<protection_and_distribution>	For detailed information about the protections and the distribution	xs:complexType

Annex E (informative): Bibliography

- IEC / EN 62040: "Uninterruptible Power System (UPS)".
- ETSI TR 102 446: "Environmental Engineering (EE); General requirements for UPS for use in Telecommunications Environment".

History

Document history			
V1.1.1	August 2009	Membership Approval Procedure	MV 20091016: 2009-08-18 to 2009-10-16