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Cable modems

Battery backup for cable-based devices

ITU-T Recommendation J.199

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Battery backup for cable-based devices

Summary

This Recommendation describes the battery backup Uninterrupted Power Supply (UPS) and MIB requirements for integrated DOCSIS devices. An integrated DOCSIS device is a DOCSIS cable modem [J.112], [J.122] that has additional functionality (such as an IPCablecom MTA) integrated into it.

Source

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ITU-T Recommendation J.199

Battery backup for cable-based devices

1 Scope

This Recommendation describes the battery backup Uninterrupted Power Supply (UPS) and MIB requirements for integrated DOCSIS devices. An integrated DOCSIS device is a DOCSIS cable modem [J.112], [J.122] that has additional functionality (such as an IPCablecom MTA) integrated into it.

2 References

2.1 Normative references

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[SCTE 79-2] ANSI/SCTE 79-2 (2002), *DOCSIS 2.0 Operations Support System Interface*.

[RFC 1628] IETF RFC 1628 (1994), *UPS Management Information Base*.

2.2 Informative references

[J.122] ITU-T Recommendation J.122 (2002), *Second-generation transmission systems for interactive cable television services – IP cable modems*.

[J.126] ITU-T Recommendation J.126 (2004), *Embedded Cable Modem device specification.*

[RFC 3410] IETF RFC 3410 (2002), *Introduction and Applicability Statements for Internet Standard Management Framework.*

3 Abbreviations and conventions

3.1 Abbreviations

This Recommendation uses the following abbreviations and acronyms.

DOCSIS Data-Over-Cable Service Interface Specifications (See [J.122].)

eDOCSIS Embedded Data-Over-Cable Service Interface Specifications (See [J.126].)

LED Light-Emitting Diode

MIB Management Information Base

UPS Uninterrupted Power Supply

3.2 Conventions

Throughout this Recommendation, the words that are used to define the significance of particular requirements are capitalized. These words are:

"MUST" This word or the adjective "REQUIRED" means that the item is an absolute requirement of this Recommendation.

"MUST NOT" This phrase means that the item is an absolute prohibition of this Recommendation.

"SHOULD" This word or the adjective "RECOMMENDED" means that there may exist valid reasons in particular circumstances to ignore this item, but the full implications should be understood and the case carefully weighed before choosing a different course.

"SHOULD NOT" This phrase means that there may exist valid reasons in particular circumstances when the listed behaviour is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behaviour described with this label.

"MAY" This word or the adjective "OPTIONAL" means that this item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because it enhances the product, for example; another vendor may omit the same item.

4 UPS MIB module and LED functionality

4.1 Introduction

Integrated DOCSIS devices MAY support battery backup capabilities with Uninterrupted Power Supply (UPS) functionality. An example of such device is an IPCablecom Embedded MTA eDOCSIS device. This Recommendation extends the set of MIB modules to provide SNMP management of the UPS power source and battery backup functions.

Support for battery backup capabilities with UPS functionality is becoming important as some broadband services rely on constant uptime. The integrated DOCSIS devices UPS components consist of one or more battery packs and associated management functions to allow the control of power supply inputs and outputs. When the UPS is being provided power via the utility line (power outlet), the battery pack(s) are able to charge. When utility power is removed, the UPS component switches to the battery backup power source to provide power to the device until utility power has been reapplied or the battery pack(s) have been depleted.

Integrated DOCSIS devices that include battery backup with UPS functionality MUST include a Battery LED that relays information on the status of the UPS and battery pack(s). For more information about the Battery LED requirements, refer to 4.2.2.

Figure 1 describes the typical functional blocks of a UPS component connected to an eDOCSIS device.

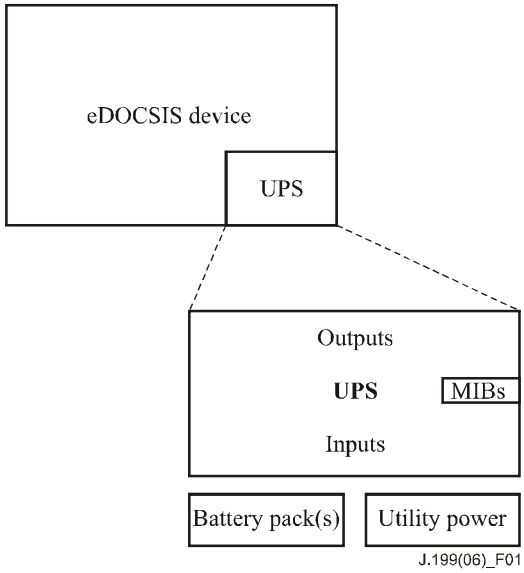

Figure 1/J.199 – UPS components in eDOCSIS devices

4.2 UPS management

The purpose of this clause is to define the UPS management requirements for integrated DOCSIS devices supporting battery backup UPS functionality.

Integrated DOCSIS devices supporting battery backup functionality MUST support UPS management and MUST comply with the SNMP MIB requirements of IETF RFC 1628 as defined in this clause. IETF RFC 1628 contains more information than is required for the simple UPS devices used for IPCablecom VoIP or HSD services. This Recommendation defines an SMI compliance statement for IETF RFC 1628 that MUST be supported by integrated DOCSIS devices with UPS functionality.

4.2.1 Battery backup UPS MIB module requirements

The battery backup UPS MIB objects MUST be implemented as defined in Annex A.

4.2.2 Power and battery LED requirements

In order to have effective communication between the operator's maintenance staff and the customers, it is necessary to have a standardized LED arrangement. The power and battery LED indicators should be implemented according to national practice. If there is no national practice on this item, the requirements in the remainder of this clause MUST be implemented.

Integrated DOCSIS devices with UPS functionality MUST provide a special LED labelled as "BATTERY" (referred to as BATTERY LED or Battery LED in this Recommendation). The BATTERY LED conventions MUST comply with the requirements defined in Table 1. The "POWER" LED of integrated DOCSIS devices with UPS functionality MUST also support the additional requirements defined in Table 1 when the device is running on battery backup power.

The Power and Battery LED requirements and location on integrated DOCSIS devices with UPS functionality MUST be consistent with the requirements in Section 7 of the DOCSIS 2.0 OSSI specification.

Table 1 defines the LED functionality used to relay power and battery status information:

Table 1/J.199 – Power and battery LED operations by state

Mode of operation	UPS power input source	Battery status	POWER LED requirements	BATTERY LED requirements
Device initialization			Unlit	Lit
	AC power (AC power is ON)	Good battery	Lit	Lit
		Low battery	Lit	Flash
		Bad battery	Lit	Unlit
Normal operation	Battery power (AC power is OFF, battery input source is ON)	Good battery	Flash	Unlit
		Low battery	Flash	Flash
		Bad battery	Unlit (see Note)	Unlit
NOTE – During AC Power Fail with a bad battery, device operation may not be possible due to lack of battery power; the POWER and BATTERY LEDs may be 'Unlit'.				

The Battery LED MUST be 'Lit' under the following conditions:

- The Battery LED MUST be 'Lit' during the initialization of all the components attached to the UPS (the list of components or eSAFE devices attached to the UPS is defined by the `upsIdentAttachedDevices` object in the `CLAB-UPS-MIB` module).
- The Battery LED MUST be 'Lit' if the eDOCSIS UPS is operating on AC power and the battery is functioning normally.

The Battery LED MUST be 'Unlit' under the following conditions:

- One or more batteries are determined to be in "bad" condition. A battery "bad" condition occurs when one or more batteries have been determined to require replacement, for example when a battery is malfunctioning or may not be rechargeable. Such condition also triggers the `upsAlarmBatteryBad` alarm in the `CLAB-UPS-MIB` module.
- The UPS is operating on battery power and the battery is functioning normally.

The Battery LED MUST 'Flash' under the following condition:

- The Battery LED MUST 'Flash' if the battery is low. A low battery condition is reached when the remaining battery run-time is less than or equal to the value of the `upsConfigLowBattTime` MIB object in the `CLAB-UPS-MIB` module (such condition also triggers the `upsAlarmLowBattery` alarm condition).

4.2.3 Applicability of the battery backup UPS MIB module requirements

The battery backup and UPS functionality may be implemented in various Cable devices, for example an IPCablecom Embedded Multimedia Terminal Adapter (E-MTA), a standalone Cable Modem or any eDOCSIS device. This clause specifies additional applicability statements.

4.2.3.1 IPCablecom E-MTA devices

In the case of an IPCablecom Embedded Multimedia Terminal Adapter (E-MTA) device used to provide telephony services, service uptime is critical and the usage of battery backup UPS components may be an operator requirement.

An IPCablecom E-MTA supporting battery backup UPS functionality MUST provide UPS output power to both the embedded cable modem (eCM) and the MTA eSAFE device (eMTA). Therefore, the `upsIdentAttachedDevices` object MUST contain the value '`ECM:EMTA`' (without the single quotes).

Annex A

Battery backup UPS MIB module

```
CLAB-UPS-MIB DEFINITIONS ::= BEGIN

IMPORTS
    MODULE-IDENTITY         FROM SNMPv2-SMI      -- RFC 2578
    MODULE-COMPLIANCE       FROM SNMPv2-CONF     -- RFC 2580

    clabCommonMibs          FROM CLAB-DEF-MIB

    upsIdentManufacturer,
    upsIdentModel,
    upsIdentAgentSoftwareVersion,
    upsIdentName,
    upsIdentAttachedDevices,
    upsBatteryStatus,
    upsSecondsOnBattery,
    upsEstimatedMinutesRemaining,
    upsEstimatedChargeRemaining,
    upsInputLineBads,                           -- optional
    upsInputNumLines,
    upsInputFrequency,                          -- optional
    upsInputVoltage,                            -- optional
    upsOutputSource,
    upsOutputFrequency,                         -- optional
    upsOutputNumLines,
    upsOutputVoltage,                           -- optional
    upsAlarmsPresent,
    upsAlarmDescr,
    upsAlarmTime,
    upsShutdownType,
    upsShutdownAfterDelay,
    upsStartupAfterDelay,
    upsRebootWithDuration,
    upsAutoRestart,                             -- optional
    upsConfigInputVoltage,                      -- optional
    upsConfigInputFreq,                         -- optional
    upsConfigOutputVoltage,                     -- optional
    upsConfigOutputFreq,                        -- optional
    upsConfigOutputVA,                          -- optional
    upsConfigOutputPower,                       -- optional
    upsConfigLowBattTime,
    upsConfigAudibleStatus                      -- optional
                            FROM UPS-MIB;       -- RFC 1628

clabUpsMib MODULE-IDENTITY
    LAST-UPDATED "200501280000Z" -- January 28, 2005
    ORGANIZATION "Cable Television Laboratories, Inc."
    CONTACT-INFO
           "Sumanth Channabasappa - CableLabs
            Postal: Cable Television Laboratories, Inc
            858 Coal Creek Circle
            Louisville, CO 80027
            U.S.A.
            Phone: +1 303 661 9100
            Fax: +1-303 661-9199
            E-mail:mibs@cablelabs.com
```

```
            Acknowledgements:
            Jean-Francois Mule - CableLabs, Inc.
            Kevin Marez, Motorola, Inc."
    DESCRIPTION
           "This MIB module provides the management objects for
            the configuration and monitoring of the battery backup
            & UPS functionality for Cable compliant devices."

    ::= { clabCommonMibs 1 }

-- Administrative assignments

clabUpsNotifications OBJECT IDENTIFIER ::= { clabUpsMib 0 }
clabUpsObjects       OBJECT IDENTIFIER ::= { clabUpsMib 1 }
clabUpsConformance   OBJECT IDENTIFIER ::= { clabUpsMib 2 }

-- Object Groups
-- The object groups used in this MIB module are imported from
-- the IETF RFC 1628; see the module compliance statement

-- Conformance Statements
   clabUpsCompliances OBJECT IDENTIFIER ::=
                                        { clabUpsConformance 1 }
   clabUpsGroups OBJECT IDENTIFIER      ::=
                                        { clabUpsConformance 2 }

clabUpsMibCompliance MODULE-COMPLIANCE
       STATUS     current
       DESCRIPTION
               "The compliance statement for Cable compliant
                devices that implement battery backup and UPS
                functionality."

       MODULE UPS-MIB -- RFC 1628
           MANDATORY-GROUPS  {
                     upsSubsetIdentGroup,
                     upsFullBatteryGroup,
                     upsBasicInputGroup,
                     upsBasicOutputGroup,
                     upsBasicAlarmGroup,
                     upsBasicControlGroup,
                     upsBasicConfigGroup
                     }

   -- upsSubsetIdentGroup OBJECT-GROUP
   --    OBJECTS { upsIdentManufacturer, upsIdentModel,
   --              upsIdentAgentSoftwareVersion, upsIdentName,
   --              upsIdentAttachedDevices }

   OBJECT       upsIdentManufacturer
   DESCRIPTION
      "The value of the upsIdentManufacturer object MUST contain
       the name of the device manufacturer."

   OBJECT       upsIdentModel                  -- same as RFC 1628
   DESCRIPTION
      "The UPS Model designation."

   OBJECT       upsIdentAgentSoftwareVersion   -- same as RFC 1628
   DESCRIPTION
      "The UPS agent software version.
       This object may have the same value as the
       upsIdentUPSSoftwareVersion object."
```

```
   OBJECT       upsIdentName
   DESCRIPTION
      "The upsIdentName object identifies the UPS and its value
       SHOULD be provided in the device configuration file. If the
       upsIdentName value is not provided in the configuration
       file, the default value MUST be an empty string."

   OBJECT       upsIdentAttachedDevices
   DESCRIPTION
      "The upsIdentAttachedDevices MUST contain the list of
       devices attached to the UPS power output.
       The value of the upsIdentAttachedDevices object SHOULD
       follow the naming conventions defined for Cable DHCP
       option 43 sub-option 3.
       For example, if the eDOCSIS device is an E-MTA with an
       integrated eCM and an eMTA eSAFE, this object must contain
       the value 'ECM:EMTA' (without the single quotes)."

   --   upsFullBatteryGroup OBJECT-GROUP
   --    OBJECTS { upsBatteryStatus, upsSecondsOnBattery,
   --              upsEstimatedMinutesRemaining,
   --              upsEstimatedChargeRemaining }

   OBJECT       upsBatteryStatus
   SYNTAX     INTEGER {
       batteryNormal(2),
       batteryLow(3),
       batteryDepleted(4)
   }
   DESCRIPTION
      "The support of the upsBatteryStatus object value unknown(1)
       is not required."

   OBJECT       upsSecondsOnBattery
   DESCRIPTION
      "If the device is on battery power, the
       upsSecondsOnBattery object MUST return the elapsed time
       since the UPS last switched to battery power, or the
       time since the device was last restarted, whichever is
       less.
       The upsSecondsOnBattery object MUST return a value of 0 if
       the attached devices are not on battery power."

   OBJECT       upsEstimatedMinutesRemaining   -- same as RFC 1628
   DESCRIPTION
      "An estimate of the time to battery charge depletion
       under the present load conditions if the utility power
       is off and remains off, or if it were to be lost and
       remain off."

   OBJECT       upsEstimatedChargeRemaining    -- same as RFC 1628
   DESCRIPTION
      "An estimate of the battery charge remaining expressed
       as a percent of full charge."

--   upsBasicInputGroup OBJECT-GROUP
--       OBJECTS { upsInputLineBads, upsInputNumLines,
--                 upsInputFrequency, upsInputVoltage }

   OBJECT       upsInputLineBads
   DESCRIPTION
      "The upsInputLineBads object MAY be supported."
```

```
   OBJECT       upsInputNumLines
   DESCRIPTION
      "The upsInputNumLines object specifies the number of input
       lines utilized in this device.
       For example, for an eDOCSIS E-MTA device with 1 battery
       pack and 1 AC power source, this object value must be 2."

   OBJECT       upsInputFrequency
   DESCRIPTION
      "The upsInputFrequency object MAY be supported."

   OBJECT       upsInputVoltage
   DESCRIPTION
      "The upsInputVoltage object MAY be supported."

--   upsBasicOutputGroup OBJECT-GROUP
--       OBJECTS { upsOutputSource, upsOutputFrequency,
--                 upsOutputNumLines, upsOutputVoltage }

   OBJECT       upsOutputSource
   SYNTAX INTEGER {
       none(2),
       normal(3),
       battery(5)
   }
   DESCRIPTION
      "The devices capable of supporting battery backup and UPS
       functionality MUST support the upsOutputSource values of
       none(2), normal(3), battery(5). The upsOutputSource value
       of other(1) may be used to represent transient states."

   OBJECT       upsOutputFrequency
   DESCRIPTION
      "The upsOutputFrequency object MAY be supported."

   OBJECT       upsOutputNumLines
   DESCRIPTION
      "The upsOutputNumLines object specifies the number of output
       lines utilized in this eDOCSIS device.
       For example, for an eDOCSIS E-MTA devices with both the eCM
       and eMTA attached to the UPS, this object value must be 2."

   OBJECT        upsOutputVoltage
   DESCRIPTION
      "The upsOutputVoltage object MAY be supported."

--   upsBasicAlarmGroup OBJECT-GROUP
--       OBJECTS { upsAlarmsPresent, upsAlarmDescr, upsAlarmTime }

   OBJECT       upsAlarmsPresent               -- same as RFC 1628
   DESCRIPTION
      "The upsAlarmsPresent object indicates the current number of
       active alarm conditions."

   OBJECT       upsAlarmDescr
   DESCRIPTION
      "The following well known alarm types MUST be supported by
       the Cable UPS capable devices:
          upsAlarmBatteryBad,
          upsAlarmOnBattery,
          upsAlarmLowBattery,
          upsAlarmDepletedBattery,
          upsAlarmOutputOffAsRequested,
          upsAlarmUpsOutputOff,
```

```
           upsAlarmGeneralFault,
           upsAlarmAwaitingPower,
           upsAlarmShutdownPending,
           and upsAlarmShutdownImminent."

   OBJECT       upsAlarmTime                    -- same as RFC 1628
   DESCRIPTION
      "The upsAlarmTime object indicates the value of sysUpTime
       when the alarm condition was detected."

--   upsBasicControlGroup OBJECT-GROUP
--       OBJECTS { upsShutdownType, upsShutdownAfterDelay,
--                 upsStartupAfterDelay, upsRebootWithDuration,
--                 upsAutoRestart }

   OBJECT       upsShutdownType
   SYNTAX     INTEGER {
                        output(1)
                      }
   DESCRIPTION
      "The upsShutdownType object defines the nature of the action
       to be taken at the time when the countdown of the
       upsShutdownAfterDelay and upsRebootWithDuration object
       values reach zero.
       The support for the upsShutdownType value system is not
       required (for Cable compliant devices, a system shutdown or
       reset can be achieved using other mechanisms."

   OBJECT     upsStartupAfterDelay
   SYNTAX   INTEGER (-1..604800) -- max range is 7 days or 604800 s
   DESCRIPTION
      "The upsStartupAfterDelay MUST be supported.
       The Cable devices capable of support battery backup and UPS
       functionality MUST support a maximum upsStartupAfterDelay
       value of 604800 seconds, equivalent to 7 days."

   OBJECT       upsRebootWithDuration           -- same as RFC 1628
   DESCRIPTION
      "The upsRebootWithDuration controls a reboot procedure with
       a countdown. It also indicates whether a reboot procedure
       is in progress and the number of seconds remaining in the
       countdown."

   OBJECT       upsAutoRestart                  -- same as RFC 1628
   DESCRIPTION
      "The upsAutoRestart is only applicable for UPS system shutdown;
       it MAY be supported."

--   upsBasicConfigGroup OBJECT-GROUP
--       OBJECTS { upsConfigInputVoltage, upsConfigInputFreq,
--                 upsConfigOutputVoltage, upsConfigOutputFreq,
--                 upsConfigOutputVA, upsConfigOutputPower,
--                 upsConfigLowBattTime, upsConfigAudibleStatus }

   OBJECT       upsConfigInputVoltage
   DESCRIPTION
      "The upsConfigInputVoltage MAY be supported."

   OBJECT       upsConfigInputFreq
   DESCRIPTION
      "The upsConfigInputFreq MAY be supported."
```

```
   OBJECT       upsConfigOutputVoltage
   DESCRIPTION
      "The upsConfigOutputVoltage MAY be supported."

   OBJECT       upsConfigOutputFreq
   DESCRIPTION
      "The upsConfigOutputFreq MAY be supported."

   OBJECT       upsConfigOutputVA
   DESCRIPTION
      "The upsConfigOutputVA MAY be supported."

   OBJECT       upsConfigOutputPower
   DESCRIPTION
      "The upsConfigOutputPower MAY be supported."

   OBJECT       upsConfigLowBattTime           -- same as RFC 1628
   DESCRIPTION
      "The upsConfigLowBattTime specifies the value of
       upsEstimatedMinutesRemaining at which a lowBattery
       condition is declared.
       Implementation of all possible values may be onerous for
       some systems. Consequently, not all possible values must be
       supported. However, at least two different
       manufacturer-selected values for upsConfigLowBattTime MUST
       be supported."

   OBJECT       upsConfigAudibleStatus
   DESCRIPTION
      "The upsConfigAudibleStatus MAY be supported."

       ::= { clabUpsCompliances 1 }

   --
   -- Units of conformance for Cable UPS capable devices
   -- Adapted from RFC 1628, a column was added for CableLabs
   -- devices. An 'x' in the column means the object MUST be
   -- supported; all the rest is optional and left for vendor
   -- decision.



-- Summary at a glance:

   --                                  subset  basic  adv  CLAB-UPS
COMPLIANCE GROUP
   --                                                        MUST
   -- upsIdentManufacturer               x      x     x       x
upsSubsetIdentGroup
   --upsIdentModel                       x      x     x       x
upsSubsetIdentGroup
   --upsIdentUPSSoftwareVersion                x     x
   --upsIdentAgentSoftwareVersion        x      x     x       x
upsSubsetIdentGroup
   --upsIdentName                       x      x     x       x
upsSubsetIdentGroup
   --upsIdentAttachedDevices            x            x       x
upsSubsetIdentGroup
   --
   --upsBatteryStatus                   x      x     x       x
upsFullBatteryGroup
   --upsSecondsOnBattery                x      x     x       x
upsFullBatteryGroup
```

```
   --upsEstimatedMinutesRemaining                    x       x
upsFullBatteryGroup
   --upsEstimatedChargeRemaining                     x       x
upsFullBatteryGroup
   --upsBatteryVoltage
   --upsBatteryCurrent
   --upsBatteryTemperature
   --

   --upsInputLineBads                  x      x    x
   --upsInputNumLines                         x     x       x
upsBasicInputGroup
   --upsInputFrequency                        x     x
   --upsInputVoltage                          x     x
   --upsInputCurrent
   --upsInputTruePower
   --

   --upsOutputSource                   x      x     x       x
upsBasicOutputGroup
   --upsOutputFrequency                       x     x
   --upsOutputNumLines                        x     x       x
upsBasicOutputGroup
   --upsOutputVoltage                         x     x
   --upsOutputCurrent                               x
   --upsOutputPower                                 x
   --upsOutputPercentLoad                           x
   --
   --

   --upsBypassFrequency                       x     x
   --upsBypassNumLines                        x     x
   --upsBypassVoltage                         x     x
   --upsBypassCurrent
   --upsBypassPower
   --
   --
   --upsAlarmsPresent                  x      x    x       x
upsBasicAlarmGroup
   --upsAlarmDescr                     x      x    x       x
upsBasicAlarmGroup
   --upsAlarmTime                      x      x    x       x
upsBasicAlarmGroup
   --
   --upsTestId                                 x    x
   --upsTestSpinLock                          x    x
   --upsTestResultsSummary                    x    x
   --upsTestResultsDetail                     x    x
   --upsTestStartTime                         x    x
   --upsTestElapsedTime                       x    x
   --

   --upsShutdownType                   x      x     x       x
upsBasicControlGroup
   --upsShutdownAfterDelay             x      x     x       x
upsBasicControlGroup
   --upsStartupAfterDelay                     x    x       x
upsBasicControlGroup
   --upsRebootWithDuration                    x    x       x
upsBasicControlGroup
```

```
   --upsAutoRestart                    x      x    x
   --
   --upsConfigInputVoltage             x      x    x
   --upsConfigInputFreq                x      x    x
   --upsConfigOutputVoltage            x      x    x
   --upsConfigOutputFreq               x      x    x
   --upsConfigOutputVA                 x      x    x
   --upsConfigOutputPower              x      x    x

   --upsConfigLowBattTime                                    x
upsBasicConfigGroup

END
```

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