APC by Schneider Electric
SmartUPS Industrial

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SOLID STATE UNINTERRUPTIBLE POWER SUPPLY UNIT

PART 1 - GENERAL

1.1 SUMMARY

A. **Scope:** This specification describes the operation and functionality of a continuous duty, single-phase Uninterruptible Power Supply unit, hereafter referred to as the UPS.

B. **Included Features of the UPS:**
   1. The UPS utilizes double conversion online topology designed to protect electronic equipment by supplying reliable, clean power featuring extremely tight voltage and frequency regulation.
   2. Wide operating temperature range -40°C to 74°C.
   3. Field replaceable air filter.
   4. Field replaceable fan assembly.
   5. The UPS features internal bypass and input power factor correction.
   6. The primary sections of the UPS are: input disconnect and filter stage, input PFC power stage, energy storage stage (DC bus capacitor bank), output power (inverter) stage, bypass and a bidirectional DC-DC converter / battery charger. The control of power module and fault detection logic is microcontroller-based.
      a. The input disconnect and filter stage contains an input back-feed relay, input filter and transient suppression.
      b. The input PFC power stage contains non-isolated power factor correcting AC/DC converters. This converter is capable of full power operation over a very wide input voltage range.
      c. The energy storage stage is a split DC bus capacitor handling seamless transitions from battery to line and vice versa, as well as the low and high frequency power stages.
      d. The output power stage operates directly from the DC bus and 120V AC output. The AC output of the UPS is connected to the inverter or through a bypass relay to the filtered input line.
      e. The UPS contains a battery charger, which operates from the DC bus. The UPS battery system is user-replaceable. The UPS can be restarted immediately after a prolonged power outage without waiting for the battery to be recharged.
   7. The UPS provides early-warning fault analysis on batteries and will project battery replacement dates, enabling timely preventive maintenance.
   8. The UPS has flash memory to facilitate firmware upgrades.
   9. The graphical LCD display with multicolor backlight provides detailed information, with the ability to configure the display locally.
   10. An integrated Network Management Card 2 (reference APC part # AP9537SUM-FC) with Environmental Monitoring is embedded into the UPS.

C. **Performance, Design, and Configurations:** The UPS and associated equipment operates in conjunction with a primary power supply and an output distribution system to provide quality uninterrupted power for mission-critical, electronic equipment and other load devices.
   1. This specification describes the performance, functionality, and design of the UPS, the external Battery Systems, and connectivity solutions.
2. All programming and miscellaneous components for a fully operational system as described in this section are available as part of the UPS.

3. The UPS and battery packs are available in the following configurations:

<table>
<thead>
<tr>
<th>TYPE</th>
<th>MODEL</th>
<th>SKU</th>
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<td>UPS</td>
<td>APC SmartUPS Industrial 1300VA / 1300W, 120VAC In/Out RM Conformal Coated</td>
<td>XU1K3LLXXRCC</td>
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<tr>
<td>Accessories</td>
<td>APC SmartUPS Industrial Battery Harness SBS75 Cabinet Accessory 8 ft</td>
<td>XHXXS7A8F</td>
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<tr>
<td></td>
<td>APC SmartUPS Industrial Battery Harness SBS75 Cabinet Accessory 4 ft</td>
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<td>XM050DXXXA</td>
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<td>APC SmartUPS Industrial Battery Heater Mat 365 sq. in 115/120VAC Single Phase In cabinet accessory</td>
<td>XM102DXXXA</td>
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<td>APC SmartUPS Industrial Battery 50Ah 12VDC Extended Temperature Shelf Mount</td>
<td>XB050XX1XS</td>
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<td>APC SmartUPS Industrial Battery 100AH 12VDC Extended Temperature Shelf Mount</td>
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1.2 REFERENCES

A. General: The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications is the latest date as of the date of the Contract Documents, unless otherwise specified.

B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

C. International Organization for Standardization (ISO):
   1. ISO 9001, "Quality Management Systems - Requirements."
1.3 STANDARDS

A. Regulatory Compliance:

<table>
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<tr>
<th>Model Description</th>
<th>SKU</th>
<th>Approvals</th>
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<td>XU1K3LLXXRCC</td>
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1.4 SYSTEM DESCRIPTION

A. Mechanical Design

1. The UPS is contained in a Powder coated steel chassis with plastic display panel embedded into the chassis.
2. The UPS has a field replaceable filter and fan assembly.
3. The chassis weights and dimensions are:

<table>
<thead>
<tr>
<th>Description</th>
<th>SKU</th>
<th>Weight kg (lb.)</th>
<th>Height mm (in)</th>
<th>Width mm (in)</th>
<th>Depth mm (in)</th>
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<td>10.0 (22.0)</td>
<td>88 (3.46)</td>
<td>432 (17.0)</td>
<td>260 (10.2)</td>
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B. System Characteristics

1. Online Efficiency: The UPS efficiency stated here is at full load and without degradation of output regulation as specified. Efficiency is at least 90% full load for models.
2. Input:
   a. AC Input Nominal Voltage: 120 V.
   b. AC Input Voltage Window: Full Load, 85-155 V +/- 2V, 5 V hysteresis.
   c. Input Frequency Range: 40 – 70 Hz, auto-selecting.
   d. Online Input Power Factor: 0.95% for Full Charger power Load and > 75% Loads.
   e. Input Current Distortion: <5% for 100% load.
   f. Input Circuit Breaker (UPS): 30A UL Listed
   g. Input Surge Protection: 432 Joules.
3. UPS Output:
   a. Nominal Output Voltage: 120 V
   b. Output Connector: Terminal Block - Hardwire
   c. Output Frequency: 50/60 +/- 3Hz (auto-sense); 50/60 +/- 0.1 Hz (user-selectable).
   d. Output Frequency Regulation: Free Running: Nominal +/- 0.1 Hz.
e. AC output voltage distortion: 5% @ 100% full linear load; 10% @ 100% full non-linear load.
f. AC output static voltage regulation: ± 1%.
g. AC output dynamic voltage regulation: ± 5% rms in 2cycles for 10% to 90% resistive load step of the initial value.
h. Output Voltage Harmonic Distortion:
   1. <5% THD for a 100% linear load.
   2. <10% THD for a 100% non-linear load.
i. Overload Rating:
   1. Normal Operation (Online): 120Vac: 105% No Limit; 125% for 1min, 150% for 30 seconds and >175% on AC for 500mSec.
   2. Bypass Operation: Overload is limited by the internal 30A input circuit breaker feeding the UPS:
      a) Bypass is internal
      b) Voltage range: 120Vac 90-133Vac.
      c) Frequency range: 47-53 Hz or 57-63 Hz based on bypass frequency setting.
      d) Transfer time: To Bypass mode – 15ms max.
      e) Transfer time: Bypass to Online mode – 15ms max.
      f) Bypass can be commanded through the diagnostic menu
j. Output Load Power Factor Rating: 0.7 lagging to 0.7 leading.
k. Crest Factor: 3:1

6. Battery: Not supplied with UPS sold as an accessory, user must select the AH rating of the battery though the UPS user interface.
   Battery Types available: Sealed maintenance free valve regulated lead acid battery (VRLA) with suspended electrolyte, leak proof:
   1. 100 Ah qty 4 required for 48Vdc battery system
   2. 50 Ah qty 4 required for 48Vdc battery system

1.5 SUBMITTALS

A. Proposal Submittals:
   1. Product catalog sheets or brochures.
   2. Product guide specifications.
   4. System package submittal drawings including a single-line and mechanical diagrams.

B. Delivery Submittals:
   User Manual: which includes safety information, specifications, UPS features, configuration, UPS settings and troubleshooting information, accessories details, installation details, and start-up of UPS.

1.6 PROJECT CONDITIONS

A. Environmental Requirements: The UPS is designed to be installed inside an Intelligent Traffic System cabinet i.e. NEMA, Caltrans etc. The cabinet should be weather proof and have particulate filtering in lieu of the filtering provided by the UPS. The UPS should be kept dry as possible if being serviced in wet weather.

   The UPS is capable of withstanding any combination of the following environmental conditions in which it must operate without mechanical or electrical damage, or degradation of operating characteristics.

   a. Storage Ambient Temperature: -45 to 85°C UPS only (without batteries)
   b. Operating Ambient Temperature: -40°C to 74°C (LCD display -20 to 70C)
   c. Relative Humidity: 0% to 95% non-condensing.
   d. Altitude:
      1. Storage Altitude: 0 to 50,000 feet (0 to 15,000 meters) above sea level
      2. Operating Altitude: 0 to 10,000 feet (0 to 3000 meters) above sea level. At altitude of 10,000 feet the UPS must be loaded only up to 90% of its nominal capacity.
1.7 WARRANTY

A. Limited Warranty: Schneider Electric IT Corporation (SEIT) warrants the UPS to be free from defects in materials and workmanship for a period of 3 years from the date of purchase,

1. Warranty Limitations:
   a. The obligation of Schneider Electric IT Corporation (SEIT) under this warranty is limited to repairing or replacing, at its own sole option, any defective product.
   b. This warranty does not apply to equipment that has been damaged by accident, negligence, or misapplication or has been altered or modified in any way.
   c. This warranty applies only to the original purchaser who must have properly registered the product within 10 days of purchase.
   d. EXCEPT AS PROVIDED HEREIN, Schneider Electric IT Corporation (SEIT) MAKES NO WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Some states do not permit limitation or exclusion of implied warranties; therefore, the aforesaid limitation(s) or exclusion(s) may not apply to the purchaser.
   e. EXCEPT AS PROVIDED ABOVE, IN NO EVENT WILL Schneider Electric IT Corporation (SEIT) BE LIABLE FOR DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OF THIS PRODUCT, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE. Specifically, Schneider Electric IT Corporation (SEIT) is not liable for any costs, such as lost profits or revenue, loss of equipment, loss of use of equipment, loss of software, loss of data, costs of substitutes, claims by third parties, or otherwise.
   f. This warranty gives you specific legal rights and you may have other rights that vary from state to state.

2. Warranty Procedures:
   a. To obtain service under warranty the purchaser must obtain a Returned Material Authorization (RMA) number from customer support.
   b. Products must be returned with transportation charges prepaid and must be accompanied by a brief description of the problem encountered and proof of date and place of purchase.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Products specified is SECUREUPS Uninterruptible Power Supply UNIT as manufactured by APC by Schneider Electric and as listed on page 2 of this specification. Items specified are to establish a standard of quality for design, function, materials, and appearance. Equivalent products by other manufacturers are acceptable. The Architect/Engineer will be the sole judge of the basis of what is equivalent.

2.2 MODES OF OPERATION

A. Normal: The UPS output power stage (inverter) constantly recreates the UPS output AC voltage waveform by converting the DC bus voltage to AC voltage through a set of IGBT switches. In both online operation and battery operation, the output power stage (inverter) creates an output voltage waveform independent of the mains input voltage waveform. Input voltage anomalies such as brown-outs, spikes, surges, sags, and outages do not affect the amplitude or sinusoidal nature of the recreated output voltage sine wave of the output power stage (inverter). The input Power Factor Correction (PFC) power stage and the output power stage (inverter) operate in an on-line manner to
continuously regulate power to the critical load. The input PFC stage is capable of full battery recharge while simultaneously providing regulated power to the load for all line and load conditions within the range of the UPS specifications.

1. **Overload Capability:** See above specification
2. **Output Relay:** The output power stage (inverter) is equipped with an output mechanical relay to provide physical isolation of the inverter from the critical bus. The UPS when installed with Bypass Panel allows the user to replace the failed UPS from the critical bus without interruption.
3. **Battery Protection:** The inverter is provided with monitoring and control circuits to limit the level of discharge on the battery system. The UPS employs a DC Breaker to protect the system from shorting of the battery supply. The battery harness which is sold as an accessory employs fuse protection.

**B. Battery:** Upon failure of the AC input source, the critical load continues being supplied by the output inverter, which derives its power from the battery system. There is no interruption in power to the critical load during both transfers to battery operation and retransfers from battery to normal operation.

1. The UPS battery system and battery harness are sold separately as accessories. Batteries can be purchased in a 50 AH or 100 AH configuration, a total of 4 batteries are needed to create the 48VDC that the UPS battery input requires. These replacement batteries are user-replaceable.
2. The batteries of the UPS models in this specification are maintenance-free, leak-proof, valve-regulated lead-acid (VRLA) batteries with suspended electrolyte.
3. The UPS incorporates the Intelligent Battery Management system to continuously monitor the health of the battery system. This UPS notifies the user in the event that a failed or weak battery module is found.
4. The UPS is not shipped with batteries; they must be purchased separately.

**C. Charging:** Upon restoration of the AC input source, the UPS simultaneously recharges the battery and provides regulated power to the critical load.

1. The intelligent battery management system contains a temperature monitoring circuit and temperature compensation algorithm that regulates the battery charging voltage and current so as to optimize battery life.
2. The battery charging circuit remains active when in bypass or online states.
3. The UPS can be restarted immediately after a prolonged power outage without waiting for the battery to be recharged.

**D. Bypass:** During bypass operation the utility power is connected to the load, bypassing the internal converters. The system automatic bypass provides a transfer of the critical load from the Inverter output to the automatic bypass input source during times when the inverter cannot support the load. The design of the automatic bypass switch power path consists of a bypass relay.

1. **Automatic Transfers:** An automatic transfer of load to bypass takes place if the load on the critical bus exceeds the overload rating of the UPS. Automatic transfers of the critical load from bypass back to normal operation takes place when the overload condition is removed from the critical bus output of the system or when other causes are corrected. When the system is in bypass mode, if power If the bypass mode becomes available, the UPS will automatically switch to mains power. In the event that mains power is unavailable the system will switch to battery power.
2. **Manual Transfers:** Manually initiated transfers to and from bypass may be initiated by the user display interface.

### 2.3 INPUT PFC POWER STAGE

**A. General:** The input Power Factor Correction (PFC) power stage of the UPS constantly rectifies the power imported from the mains input of the system, converting input mains AC power to DC power for precise regulation of the DC bus voltage, battery charging, and output power stage (inverter) regulated output power.

**B. Input Current Total Harmonic Distortion:** The input current THDi at full system load will be held to 7% at 50% load and 5% at full load while providing conditioned power to the
critical load bus and charging the batteries under steady-state operating conditions. This is true while supporting loads of both a linear or nonlinear type. This will be accomplished with no additional filters, magnetic devices, or other components.

C. **Input Current Limit:**
   1. In cases where the source voltage to the UPS is nominal and the applied UPS load is equal to or less than 100% of UPS capacity, input current will not exceed 165% of UPS output current, while providing full battery recharge power and importing necessary power for system losses.

D. **Charging:**
   1. The battery charging circuit contains a temperature monitoring circuit, which regulates the battery charging current to optimize battery life.
   2. The battery charging circuit remains active when the UPS is in automatic bypass and in normal operation.
   3. The UPS charging circuit can deliver charge current at 15 Amps. Charge current is automatically adjusted with Battery AH, temperature and load.

2.4 OUTPUT POWER STAGE (INVERTER)

A. **General:** The UPS output power stage (inverter) constantly recreates the UPS output voltage waveform by converting the DC bus voltage to AC voltage through a set of IGBT-driven power converters. In both normal operation and battery operation, the output power stage (inverter) creates an output voltage independent of the mains input voltage. Input voltage anomalies such as brown-outs, spikes, surges, sags, and outages, shall not affect the amplitude or sinusoidal nature of the recreated output voltage sine wave of the output power stage (inverter).

B. **Overload Capability:** The output power stage (inverter) is capable of withstanding 150% overload for 30 seconds or 125% overload for 1 minute or 105% overload for indefinite length of time.

C. **Output Relay:** The output power stage (inverter) is equipped with an output mechanical contactor to provide physical isolation of the inverter from the critical bus. With this feature a failed inverter will be removed from the critical bus. The UPS when installed with Bypass panel, has the provision of isolating the defective UPS from the critical Bus. This is achieved through Contactors used in the Bypass panel. This feature allows the user to replace the defective UPS without disrupting the power to the critical loads.

D. **Battery Protection:** The inverter is provided with monitoring and control circuits to limit the level of discharge on the battery system. The UPS comes with a 48VDC breaker to protect the battery supply. The battery harness is fused adding an additional layer of protection.

2.5 DISPLAY AND CONTROLS

A. **Control Logic:** The UPS is controlled by an embedded microcontroller which performs the following functions:
   1. Monitoring the quality of the output voltage.
   2. Monitoring vital parameters of the UPS.
   3. Executing the state machine.
   4. Intelligent battery management.
   5. Controlling the input and output power stage.
   6. Remaining runtime calculation.
   7. Self-diagnostics, self-test, and proactive fault detection.
   8. Communication to the host server via a serial port.
   9. Communication to the integrated Network Management Card.

B. **Display Interface:** Located on the front of the UPS is an LCD user display comprised of a graphical, high resolution (3”x3”) LCD (256 x 128 Pixels) and 5 pushbutton switches. **Control Functions:** The following controls functions can be accomplished by use of the pushbutton switches:
   1. Power On/Off button.
2. Escape button.
3. OK button.
4. Up button.
5. Down button.

C. **Data displayed on the Display Interface:** The following indicators are available on the Display Interface Unit:
   1. Load icon and disable/mute audible alarm icon.
   2. The UPS status information (Input and Output Voltage, Output Frequency, Load, and Runtime).
   3. Operation mode icons (On-Line mode, Bypass mode, and Battery mode).
   4. Battery status icons.
   5. Programmable Output relay positions (NO/NC).
   6. Backlight screens: Amber is an indication that requires attention and Red indicates a UPS alarm that requires immediate attention.

D. **Audible Alarms:** Using audio signal, the UPS will notify the user about important events. The following is the list of distinct audio alarms:
   1. The UPS is on battery.
   2. The UPS is on battery and the remaining battery capacity is low.
   3. The UPS has shut down due to low battery capacity.
   4. The battery needs to be replaced.
   5. The UPS is overloaded.
   6. The UPS is in fault state.

E. **Output Relays:** The UPS provides 6 programmable Output relay ports on the front panel:
   
The following function can be programmed to each output relays.
   1. On Battery
   2. On Battery Peak
   3. Low Battery
   4. Alarm
   5. Fault
   6. Output ON
   7. Output Off
   8. Online (Inverter Mode)
   9. Bypass
   10. Timer – Peak load, ON battery,

F. **Input Contacts:** The UPS provides 2 programmable Input contacts on the front panel:
   
The following function can be programmed to each input contacts.
   1. Self-Test
   2. Alarm ON(External Alarms to System)
   3. Alarm OFF(External Alarms to System)
   4. Output ON
   5. Output OFF

G. **Flash Mode Setting:**
   1. Signal flash Voltage (Battery Voltage): Can be configured by the user to enable the flash mode operation.
   2. Peak Period Configuration: Can be configured to any day from Monday to Sunday and to any time of 48 slots available, each slot of 30min in a day 24 hour. If output relay configured to OnBatteryPeak, relay will not get activated during the peak period.

H. **Communication Interface:** For purposes of remote communications with the UPS the following are available and contained within the UPS:
   1. The UPS has the following ports available; serial port (RJ45 – for manufacturing purposes only, USB Host port for use with a USB flash drive, Service Bypass Unit Connector which allows communication to the Service Bypass Units (sold separately).
2. Ethernet Port allows communications over a network via web browser or SNMP or with APC StruxureWare™ management software.
3. Universal I/O port can be used to connect Temperature/Humidity sensors for environment monitoring.

2.6 BATTERY

A. The UPS does not ship with batteries. Batteries can be purchased separately and are available in 50AH and 100AH formats. Other amp hour types can be used but the user must program the battery amp hour into the UPS to ensure appropriate charging of the battery system.
B. Battery Temperature Sensor connector – Used with the battery system, monitors the temperature of the battery system which is used by the UPSs temperature compensated charger circuitry.
C. The batteries are of the valve regulated lead acid (VRLA) type.

2.7 SMART BATTERY MANAGEMENT

A. Features:
   1. Monitors and informs the user of the health of each battery system.
   2. Monitors and shows on the UPS Display Interface screen the date for the end of useful life for the battery system.
   3. Emits an alarm and shows a message on the UPS Display Interface screen to indicate the estimated battery end of life. On the UPS Display Interface screen, the user can set the number of days before the alarm is heard and the message appears on the UPS Display Interface screen.
   4. Monitors the temperature of the battery system and automatically adjusts the battery charging.
B. Maintenance:
   1. Uses sealed lead acid battery cells and does not require maintenance.
   2. Runtime Test (Calibration): This should be performed anytime the steady state load is changed significantly, for example when a new server is added to or removed from the UPS load.
   3. Battery health monitoring: The battery energy output and voltage are monitored to assess the health of the installed batteries when the UPS is operating on battery.
   4. Battery health monitoring is done during a UPS Self-Test, during a Runtime Calibration Test, and when the UPS is operating on battery power. The UPS can be configured to perform periodic, automatic Self Tests.
C. End of useful life
   1. Near end of life notification: A warning message will appear on the UPS display interface screen when the battery system is approaching the end of its useful life. For configuration details refer to Replacement Notification Time and Replacement Battery Alarm Time. The estimated replacement date for the battery system is available through the UI.
   2. Needs replacement notification: The UPS display interface screen shows when the battery system replacement is required. The battery system must be replaced as soon as possible.
   3. Recycling: Please recycle the battery system.

2.8 ACCESSORIES

A. Service Bypass Unit (SBU): The service bypass unit provides power to the critical load bus from the bypass source during times when maintenance or service of the UPS is required. The SBU provides a mechanical means of complete isolation of the UPS from the electrical wiring of the installation. The SBU is constructed in a rack-mounted or wall-mounted 1U size enclosure unless otherwise stated in this specification.
B. **Remote UPS Monitoring:** The following methods of remote UPS monitoring are available:

1. **Web Monitoring:** Remote monitoring is available via a web browser such as Internet Explorer.

C. **Software Compatibility:**

1. **PowerChute Network Shutdown:** This software is provided with the integrated Network Management Card. Please refer to this [link](#) for the latest software compatibility listing.

**PART 3 – EXECUTION**

3.1 **FIELD QUALITY CONTROL**

A. **Manufacturer Field Service:**

1. **Worldwide Service:** The UPS manufacturer has a worldwide service organization available, consisting of factory-trained field service personnel to perform startup, preventive maintenance, and service of the UPS system and power equipment. The service organization offers service support 24 hours a day, 7 days a week, 365 days a year.

2. **Replacement Parts:** Parts are available through the worldwide service organization 24 hours a day, 7 days a week, 365 days a year. The worldwide service organization is capable of shipping parts within four working hours or on the next available flight, so that the parts may be delivered to the customer site within 24 hours.

3.2 **MAINTENANCE**

A. A complete offering of preventive and full-service maintenance contracts for the UPS system and the battery system are available from APC by Schneider Electric. Contract work is performed by Schneider Electric factory-trained service personnel.

END OF GUIDE SPECIFICATION

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