**Product guide specification**

**Cyberex® Power Distribution Unit**

**PDU 50 – 300kVA**

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# General

## Summary and scope

The following technical specification describes the requirements of the power conditioning/distribution module for distribution of computer grade power to the data processing equipment and other critical loads. The system shall be known as a Power Distribution Unit (PDU).

## Standards

The PDU shall be designed, tested (or certified) and manufactured to the following standards:

* ETL listed to UL 60950-1
* ETL listed to UL 891
* cETL listed to CAN/CSA C22.2 No. 60950-1

## Definitions

The following definitions shall apply throughout this specification:

* Owner, User or Buyer – the owner; or the owner’s designated representative(s).
* Manufacturer – the firm or corporation who will manufacture and deliver the PDU equipment specified herein.
* Specifications – the technical instructions described or portions of standards referenced herein, and any addenda thereto.

## System description

### Environmental requirements

The PDU shall be capable of withstanding any combinations of the following environmental conditions without mechanical or electrical damage or degradation of operation.

* Operating ambient temperature: 0 to 40°C.
* Non-operating storage temperature: -40 to 60°C.
* Relative humidity: 10 to 95% non-condensing.
* Maximum operating altitude without de-rating:
  + 1000m (3300ft) above sea level.
  + De-rating factor for altitudes greater than 1000m shall be 0.3% for every 100m above 1000m.
* Non-operating altitude: 15,000m

### Electrical characteristics

* The PDU shall have a full load continuous capacity of [50] [75] [100] [125] [150] [200] [225] [300] kVA.
* The input voltage to the PDU shall be 480 VAC, three (3) phase, three (3) wire plus ground @ 60 Hz.
* The output voltage from the PDU shall be 208/120 VAC wye, three (3) phase, four (4) wire plus ground @ 60 Hz.

## Warranty

The PDU manufacturer shall guarantee the entire system against defective material and workmanship for a period of one (1) year from date of shipment.

With purchase of factory start-up services and used in the continental United States, the manufacturer shall include labor and expenses for a period of one (1) year from date of the factory start-up, not to exceed eighteen (18) months from date of factory shipment.

# Product

## Manufactured units

2.1.1 PDU manufacturers: Subject to compliance with requirements, provide products by ABB (Cyberex®).

## Components

### Cabinet construction: Main transformer cabinet

* The PDU’s primary element is the main transformer cabinet intended to house the main input connection, main input breaker, the transformer and basic metering and communications electronics. The main transformer cabinet may also include power distribution devices such as panel boards and sub feed circuit breakers which will be covered in other sections of this specification.
* The PDU main transformer cabinet enclosure shall be designed for placement on the computer room raised floor or on concrete floor. The system shall not exceed 34"W, 34"D, and 77.4"H.

*(Specifier’s Note: Certain 300kVA transformer options may require a larger cabinet. See PDU 350 – 800kVA guide specification document for details regarding cabinet dimensions.)*

* The main transformer cabinet enclosure shall be a single bay vertical cabinet using natural convection for cooling purposes. Forced air (fan) cooling is expressly forbidden via this specification.

### Cabinet construction: Distribution side cars

The PDU shall be provided with [1] [2] [3] distribution side cars for additional distribution devices as follows:

* [quantity] 10” Side-facing side car
* [quantity] 24” Front-facing [and Rear-facing] side car
* [quantity] 34” Front-facing [and Rear-facing] side car

The side cars shall be affixed to the left and/or right sides of main transformer cabinet to form a continuous equipment line-up of uniform height and depth. The 34” and 24” front-facing (but not the 10” side-facing) side cars shall be provided with swivel casters and stabilizing feet (see Cabinet Construction: General).

### Cabinet construction: General

* The PDU frame shall be constructed of steel and welded to provide a strong substructure.
* The PDU cabinet enclosures shall be mobile and contain four (4) 360° swivel casters and four (4) stabilizing feet for stability purposes.
* The PDU cabinet enclosures shall be painted standard Cyberex® black to complement the data processing equipment in this facility. The paint shall be applied using powder coating methods and shall be heat treated and matte finished to help protect the surface of the PDU.

### Cabinet access

Cabinet access shall be as follows:

* Front access required for operation.
* Side access required for operation of the side-facing side car.
* Rear access required for operation of rear-facing side car.
* Left, right, or rear access required for servicing the main transformer cabinet. If side cars are placed on both sides of the main transformer cabinet, then rear access is required for service.
* Top or bottom cable entrance for main transformer cabinet. Bottom cable exit for main transformer cabinet.
* Top or bottom exit for distribution side cars.

### Input main circuit breaker

* The PDU shall include an input main circuit breaker to provide both system protection and a means of disconnecting power from the system.
* The system's input main circuit breaker shall be a 600V rated, 3-pole [thermal magnetic] [electronic trip] molded case circuit breaker, sized for 125% of the PDU full load input current rating.
* The system's input main circuit breaker shall contain an internal 24 VDC shunt trip mechanism which shall be interfaced to the local Emergency Power-Off (EPO) pushbutton on the PDU as well as remote EPO pushbutton connections for all remote needs. Customer shall provide dry contacts for remote EPO.
* The system's input main circuit breaker shall have a standard interrupt rating of 65kAIC@480V for all kVA offerings.
* Input connection shall land to bus bar with NEMA 2-hole input connections.

### Isolation transformer

The PDU shall contain an isolation, electro-statically shielded transformer for voltage step-down, isolation, and grounding purposes. The transformer shall be constructed using all copper windings and shall employ six (6), 2 1/2% full load compensation taps (two [2] above and four [4] below nominal).

The PDU isolation transformer shall have the following electrical and construction characteristics:

* Rated kVA [50] [75] [100] [125] [150] [200] [225] [300] kVA
* Primary voltage 480 VAC, 3 PH, 3 W + Ground
* Secondary voltage 208/120 VAC, 3 PH, 4 W + Ground
* Input/output frequency 60 Hz
* Efficiency DOE 2016 compliant
* Percent impedance 3.0 – 5.2%
* Percent reactance 2.0 – 4.2%
* Voltage THD (added) 1% max.
* Insulation class Class 220
* Temperature rise 150°C, optional 115°C
* Audible noise NEMA ST20
* K-rating 13, (optional 20, 9, 4)

The neutral of the isolation transformer shall be rated 2 times the system full load amps rating. This is a strict requirement of the specification due to the anticipated high nonlinear loads associated with this project.

The transformer shall contain two (2) NO thermostats per coil to monitor core temperature. The first thermal device shall operate at 190°C. The second thermal device shall operate at 220°C. In the event of a 220°C core temperature condition, the thermal overload protection device shall close a set of contacts and initiate an automatic shutdown event.

The transformer shall be cooled via natural convection.

### Output distribution options

The PDU shall be provided with the following complement of distribution options to be placed in the side cars as defined in section 2.2.2. of this specification

* 10” Side-facing side car with the following distribution devices: [choose any 2]
  + 225A ABB 42-pole ProLine panel board with [65kAIC] 225A mains *(GE optional)*
  + Grouping of up to (4) [100] [150] [225] amp, [65kAIC] ABB sub feed breakers
  + 400A, 65kAIC ABB sub-feed breaker
* 24” Front/rear-facing side car with the following distribution devices: [choose any 2 for front or any 2 for rear]
  + 225A ABB 42-pole ProLine panel board with [65kAIC] 225A mains *(GE optional, 1 per side)*
  + Grouping of up to (4) [100] [150] [225] amp, [65kAIC] ABB sub feed breakers
  + 400A, 65kAIC ABB sub feed breaker
* 34” Front/rear-facing side car with the following distribution devices: [choose any 2 for front or any 2 for rear]
  + 225A ABB 42-pole ProLine panel board with [65kAIC] 225A mains *(GE optional)*
  + Grouping of up to (4) [100] [150] [225] amp, [65kAIC] ABB sub feed breakers
  + 400A, 65kAIC ABB sub feed breaker
* Main Transformer Cabinet Distribution (34”) with the following distribution devices: [choose 2]
  + 225A ABB 42-pole ProLine panel board with [65kAIC] 225A mains *(GE optional)*
  + Grouping of up to (4) [100] [150] [225] amp, [65kAIC] ABB sub feed breakers
  + 400A, 65kAIC ABB sub feed breaker

### Panelboards general

The PDU distribution panel boards shall be:

* ABB ProLine 42-pole, [225] [400] amp, 480/277V, three (3) phase with a short circuit series rating of 35kAIC.
  + See section 2.2.10 for selective coordination for ABB ProLine branch breakers.
* GE 42-pole, [400] amp, 240V, three (3) phase with a short circuit rating of 22kAIC.

Each distribution panel board shall employ copper buss bars and shall be capable of accepting 1-pole, 2-pole, and 3-pole circuit breakers rated up to 100 amps.

Each distribution panel board shall be capable of accepting bolt-on branch circuit breakers into the panel board interior.

### Panelboard main breakers

Each 42-pole distribution panel board shall be protected by a 225A or 400A, 240V, 3-pole main circuit breaker protective device.

### Branch circuit breakers

Each branch circuit breaker protective device shall have three (3) toggle positions: ON, OFF, and TRIPPED.

ABB ProLine branch circuit breakers shall be [bolt-on] with a series rating of [10kAIC for mail lug only panels] or [35kAIC for panels with ABB Tmax main circuit breakers] and sized in compliance with the National Electric Code. ABB ProLine branch breakers are selectively coordinated with Tmax main circuit breakers up to 28.6kAIC at 208V.

GE branch circuit breakers shall be bolt-on with a [10] [22] kAIC rating and sized in compliance with the National Electric Code.

### Sub feed circuit breakers

Each ABB sub feed breaker shall be fixed-mounted and rated at 600 VAC, 3 phase, [100] [150] [225] amp, 65kAIC, 80% rated, thermal-magnetic trip. Four hundred (400) amp breakers shall be rated at 600 VAC, 3 phase, 65kAIC, 80% rated, thermal-magnetic trip.

## Monitoring system

The PDU shall be equipped with the Cyberex® PowerView Monitoring System, which interfaces with both the local color, touchscreen GUI and/or Building Management System (BMS).

### Local display

The PDU shall be equipped with an industrial use, long life, color touchscreen, liquid crystal display (LCD) for the graphical user interface (GUI). The LCD shall measure at least 6.5 inches. The display shall contain all normal operating controls, metering and status indication via an integrated LED ring-light. Additionally, the GUI shall also be able to display an event log containing the condition/alarm, time, and date of the event.

### The display panel shall become an integral part of the PDU and shall indicate the following system information:

* Serial number
* Software version
* Modbus ID
* Board temperature
* Date of last upgrade
* Date of last service
* Date of initial installation

The monitoring panel shall employ an audible alarm to annunciate fault conditions that require acknowledgment such as transformer over-temperature. The alarm shall be silenced by acknowledging the condition on the display panel.

The PDU shall continuously monitor the temperature of the main isolation transformer. The transformer shall be equipped with two (2) thermal sensors per coil, one (1) to annunciate a "High Temperature" condition and the other to automatically shut down the PDU upon a hazardous temperature condition (220°C).

The PDU shall log the “Excess Temperature Warning Threshold” event in the event log as an alarm as well as sound the audible alarm.

The PDU monitoring panel shall contain a fully-guarded, red illuminated “Emergency Power Off” pushbutton assembly. This control circuit shall be interconnected to the internal 24 VDC shunt trip mechanism and shall allow the user to open the PDU main breaker.

### Cyberex® PowerView PDU system monitoring

The following shall be metered:

* True RMS output voltages (3-phase, L-L, and L-N)
* True RMS input voltages (3-phase, L-L)
* True RMS output currents (3-phase)
* True RMS neutral current
* Frequency
* Output power (kW, kVA, kVAR)
* Output power factor
* Energy consumption (kWh, kVAh)
* Max energy demand (kWh periodic max)
* Percentage load
* Voltage THD in %
* Current THD in %
* Crest factor for load

*(Specifier’s Note: Optional current monitoring on PDU main breaker available with inclusion of CTs for main breaker.)*

The PowerView shall continuously monitor for the following alarm/warning conditions in the PDU system:

* Output under/over voltages (L-N)
* Output over currents (3-phase)
* Output over neutral and ground currents (Amps)
* Input under/over voltage (L-L)
* Under/over frequency

### User Interface Board (UIB)

The PDU shall contain a user interface board which allows the local installing electrical contractor to interconnect remote emergency power off pushbutton stations to the EPO control circuit, as well as any other customer monitoring connections.

Upon any alarm condition the system shall produce an event in the event log describing the alarm/warning condition. The system has the ability to output up to four (6) SPDT (Form C) relay contacts. The function of these relays is given below:

* Relay 1: Summary Alarm
* Relay 2: Unacknowledged Events
* Relay 3: Factory-Programmable Alarm Output
* Relay 4: Factory-Programmable Alarm Output
* Relay 5: Factory-Programmable Alarm Output
* Relay 6: Factory-Programmable Alarm Output

In addition to the above monitoring features, the system shall have the ability to accept normally open contacts from up to four (4) building interface points. The PDU monitor panel shall also allow those points to be configured as latching or non-latching (i.e. to change status back to “normal” when the normal condition returns).

### Monitoring options

* Cyberex® PowerView [Core] [Pro] Branch Circuit Monitoring (BCM) for panel boards
* Cyberex® PowerView [Core] [Pro] Sub-Feed Circuit Monitoring (SFCM) for sub-feeds

## Communications and connectivity

The PDU shall provide industry standard communications connectivity and protocols to interface with the user’s Building Management System (BMS), local network and portable devices using the following methods. The manufacturer shall provide comprehensive documentation (e.g. Modbus register maps) to facilitate the interface with the user’s systems. All communications connections shall incorporate industry standard connectors and terminal strips for user’s connections located at a central user demarcation point in the PDU.

All remote communications with the PDU using Internet, Modbus or serial protocols shall be strictly limited to monitoring and or changing alarm thresholds. There shall be no provision that allows the PDU to be remotely operated in such a way that could cause a load drop.

### Modbus over RTU (via RS 485)

The PDU shall provide serial (2 wire or 4 wire) standard Modbus connectivity over RS 485. The PDU shall be designated as “slave” and assigned a single Modbus ID.

### Modbus over TCP, via Ethernet

The PDU shall provide Modbus TCP over Ethernet.

### Serial service port, via USB

The PDU shall provide a dedicated USB service port for use by authorized field service personnel for the purposes of performing maintenance tasks including diagnostics and software upgrades. The USB service port shall also facilitate software upgrades via a USB storage device, as well as, alarm/warning and metering/configuration data downloads.

### Remote software upgrade

The PDU shall provide the following functions for communicating the status via the Internet or Intranet:

* TFTP – The PDU shall provide means for authorized field service personnel to performing remote software upgrade.

## Equipment options

Available as options, the PDU shall contain following:

* Surge arrestor (40kA)
* Input terminal block
* Branch Circuit Monitoring (BCM) with energy metering (Specifier’s note: See Cyberex® PowerView guide specification)
* Sub-Feed Circuit Monitoring (SFCM) with energy metering (Specifier’s note: Cyberex® PowerView guide specification)
* Local EPO pushbutton assembly
* Floorstand (Seismic)
* Isolated grounds for panelboards
* Kick plates

# Execution

## Overview

Factory start-up and user training, preventive maintenance service, and full service for the above specified system shall be included upon request. The manufacturer shall nationally employ service organizations of factory-trained field service personnel dedicated to the start-up, maintenance, and repair of the manufacturer’s power equipment.

The manufacturer shall maintain (24 hours per day, 365 days per year) an answering service to facilitate in providing technical support and emergency service dispatching.

### Installation, inspection and factory authorized start-up

Installation and start up shall include the following:

* Ensure removal of temporary shipping bracing.
* Verify all electrical connections for tightness as specified.
* Review the field assembly and connection of components.
* Inspect accessible components for cleanliness, for mechanical and electrical integrity, and for evidence of damage or deterioration.
* Pretest and adjust all monitoring and/or control parameters as required.
* Correct all deficiencies before proceeding with tests. Correct deficiencies identified by tests and retests.
* If applicable, adjust transformer taps to provide optimum voltage conditions at utilization equipment throughout the normal operation cycle of the facility.
* Record circuit monitors set-ups, if applicable.
* Measure output voltage of branch circuit panel board, if applicable. Verify proper operation of equipment, including circuit monitor and input and output control circuits.
* Submit test reports.

### Training (optional)

Concurrent with factory authorized system startup the manufacturer’s field service engineer shall train the owner’s operating personnel in the proper operation of the system. Training shall last a minimum of two hours and shall include:

* Safety precautions
* Features and construction of project equipment
* Voltage adjustment procedures, if applicable
* Routine inspection and test procedures
* Routine cleaning
* Interpretation of reading of warnings and alarms

**End of specification**