APPLICATION GUIDE

Maximize Uptime and Reliability
Food & Beverage industry

Driven by population and middle-class growth, changing consumer requirements, safety and quality concerns, sustainability efforts and digitalization opportunities, Food & Beverage is a rapidly expanding industry. It is one of the key markets in most countries since it fulfils society’s basic needs. According to forecasts, the F&B market will increase at a compound annual growth rate of about 9.5 percent between 2021 and 2028.

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Introduction

The Food & Beverage industry includes various segments: ingredients, dairy produce, beverages, meat, packaged food… across the full value chain from farming to food distribution and retailing. It amounts to $25+bn in electrification & automation opportunities for ABB.

The main players in the industry are food and beverage producers, machine builders, product and solution providers, system integrators, engineering and design companies, EPCs and distributors.

ABB plays on a supply side that delivers products and solutions to producers, machine builders, distributors and system integrators, while working with design and engineering companies to provide Food & Beverage industries with leading power, automation and digital solutions in an overall commitment to a sustainable food future. The purpose of this application guide is to present ABB solutions that ensure power continuity and reduce the impact of power outages in F&B process industry.

Market Trends

Market Trends

- Changing demographics
- Regulatory requirements
- Food safety focus
- Product diversification
- Increased sustainability focus
- Environment friendly processes

Production Processes

- Product quality and consistency
- Food safety, contamination free solutions, hygiene
- Traceability
- Production reliability and flexibility
- Production speed and efficiency
- Product variation
- Recyclable packaging
- Sustainable manufacturing

Manufacturing Drivers

- Focusing on plant monitoring and diagnostics
- Optimizing line speed and minimizing breakdowns for increased operational efficiency
- Process complexity management
- Convenient sourcing, preference for a smaller number of suppliers
- The need for flexible manufacturing and packaging solutions
- Energy and water efficiency improvements
- Social responsibility when using resources

Value Chain

Agriculture

Production of farming inputs

Farming

Production of raw agricultural commodities

Packaging

Ingredient processing

Minimum processing of raw agricultural commodities to use as inputs for end products

F&B processing

Conversion of ingredients and commodities into forms that can be easily consumed and distributed

Logistics

Food and beverage storage, warehousing, fulfilment and transportation

Retail

Distribution of finished goods to consumers in stores and restaurants

F&B industry focus and KPIs

Costs

TCO, OEE, Continuous operation; utilities, speed and flexibility.

Safety

Food safety, Supply safety and value chain.

Quality

Product quality, Power quality, Production reliability.

Sustainability

Efficiency, Energy savings, Water savings, reduced Waste & Scrap.

Digitalization

New business models, Industry 4.0, Connectivity, Big Data.

Food Recall

A key challenge in the F&B industry

The demand is growing and many F&B factories worldwide are operating 24/7 to meet higher efficiency, productivity, and sustainability goals.
In this era of continuous operation, uptime, and on-time delivery, F&B processors must also be able to adapt production to supply changes and demand surges.

Food safety & Product quality are two important KPIs that ingredient processing, F&B processing & packaging industries have to consider properly to avoid food recalls.

The Food and Agricultural Organization (FAO) of the United Nations defines a recall as the action to remove food from the market at any stage of the food chain, including that possessed by consumers [1].

Millions of pounds of food are recalled annually around the world, including fruit and vegetables, cereals and bakery products, meat and poultry, eggs, herbs and spices. The most common causes of food recalls in the US and EU include:

(1) Traceability & Recalls | Food safety and quality (fao.org)

Food Recall

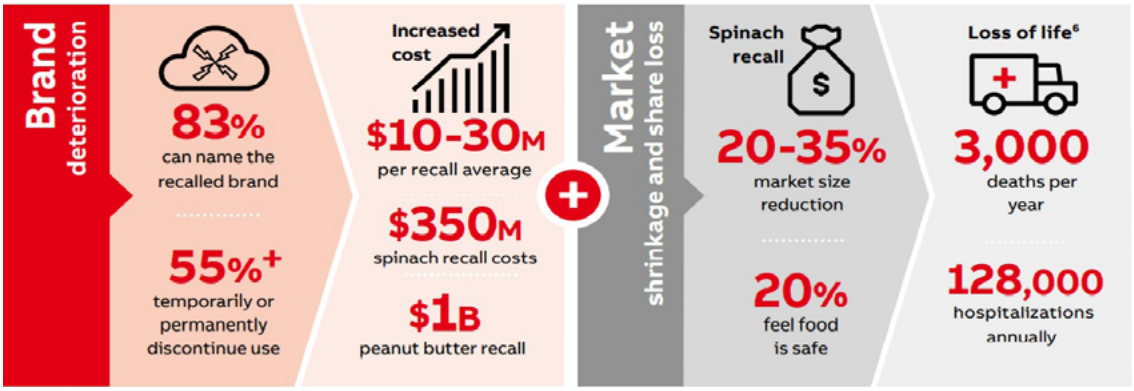
Food recalls due to processing defects

Processing defects can be caused by fluctuations or downtime in the power supply. For example, dairy producers must track the temperature of their milk with precision throughout the process. Even a small disturbance in the power system can mean discarding an entire batch of perfectly good product if it causes temperature sensors to fail. Any unexpected downtime can cause spoilage resulting in valuable milk products having to be dumped. Lost production time while more milk is sourced and sterilized can cost many hours and many thousands of dollars.

This is why proper power supply continuity is crucial in F&B processes. In recent years, the F&B industry has undergone huge transformations, with high levels of automation and the increasing demand for monitoring and information systems. This trend has been driven not only by the need to improve productivity, but also by new standards and requirements to ensure food safety. Owing to the increasing intensity of automation, food and beverage manufacturing plants are extremely sensitive to power quality events. Thus the quality level of electric power is business-critical.

Industry experts estimate that the financial impact of a food recall runs between $10 - $30 million in direct costs, and can be even higher if one considers compliance with post incident requirements, lost sales, higher insurance, brand value and more.
In addition, a food recall can also lead to brand damage and in some cases, fines and criminal charges that may also extend to the CEOs. It is also important to remember that a recall is an intensive process and becomes the top priority for a business. It interrupts other plans and requires critical communications, affecting everyone involved in making sure that the product is accounted for and destroyed to ensure consumer safety.

Impacts of a recall can add up and include:



Power Quality and Continuous power solutions

The importance of secure power

Power Quality costs in Europe are estimated to be responsible for a serious reduction in industrial performance and an economic impact of €150bn(2), while industrial analysts estimate the cost of downtime to be between $100,000 and $1million per hour.

This in addition to the impact of voltage sags which, according to EPRI, account for over 92% of financial losses in the industry due to Power Quality events. Thus reliable, smart and sustainable solutions able to secure power and ensure perfect production processes is business-critical in the F&B industry.

(2) European Power Quality survey report, J. Manson & R. Targosz, Leonardo Energy- 2008

Impact of Power Outages on Food & Beverage industry processes

- Production downtime
- Extra costs for backup electrical equipment
- Business reduction
- Inventory wastage
- Damage to machinery
- Equipment reactivations
- Delivery or service delays
- Financial losses
- Longer working hours
- Facility shutdowns

The ABB power protection portfolio comprises a comprehensive range of UPS and Power Conditioning solutions that can protect a Food & Beverage facility from disturbances in the electricity supply. Once ABB power protection is in place, Food & Beverage product quality, safety and production can be maximized, thereby ensuring full use of your facility and enhanced product quality for customers.

Our wide range of application solutions enables us to assess and address the main customer needs including:

- Continuous operation and asset optimization
- Energy-efficient solutions that reduce energy and water consumption
- Consistent energy quality
- Plant safety and reliability
- Sustainable production
- Food safety and contamination-free products
- People safety and training
- Best solution from a TCO (total cost of ownership) perspective
- Short pay-back of investments.

ABB power protection solutions can be applied to any application in the food and beverage process. Typical applications are:

Picking
Stable power becomes a necessity as automation in picking processes increases. Installation of UPS in control equipment can eliminate waste and increase output.

Mixing
requires precise control to ensure consistent product quality. Mixing machines often have high starting torque and operate at different mixing speeds. This can cause undesired voltage fluctuations within a facility, affecting sensitive equipment connected to the same power supply. Control of the power factor minimizes voltage fluctuations and penalty charges from the power utility.

Sterilization
is a key stage in nearly all food and beverage processes. Pasteurization, cooking and Ultra High Temperature (UHT) treatment rely on continuous clean power. Temperatures must be accurately controlled and often recorded to verify sterilization effectiveness. Any power event or interruption that impacts the sterilization process or temperature recording can result in lost product. Disposal of waste product and the extra time it takes to clean the system prior to resuming production can lead to significant costs.

Conveying
increased automation means that faster and more complex conveyors must be used. Bottling is a typical example. Interruptions are usually due to voltage fluctuation causing sensors, drives or controls to malfunction. Besides physical damage to the product or tools, it also results in time-outs for cleaning or repair work.

Filling
machines designed to fill dry mixes, liquid or thin food products can be subject to voltage sags. Eliminating these common power quality problems can help filling machines achieve continuous output and reduce product waste.

Packing
comprises a number of fully automated processes performed at high speed. Such processes may include product separating, weighing, vacuum packing and freezing. Disruptions to packing result in loss of product, poor quality and potential health risks if the packing is compromised.

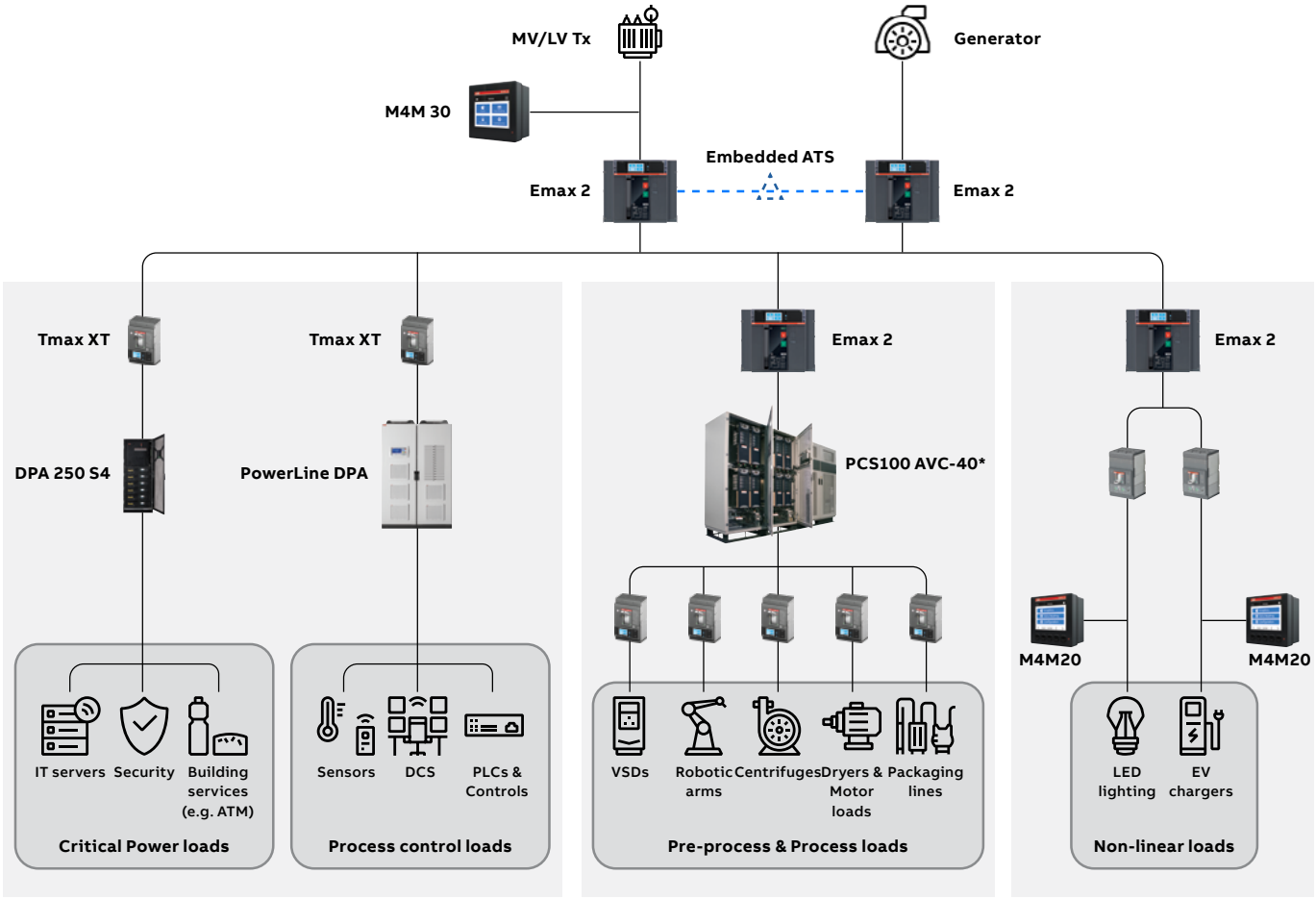
Palletizing
Often a highly automated process and the final stage after packaging. Robots are widely used and require good quality power for continuous operation. Data records from the batches must be securely acquired and stored.

Every touchpoint across food and beverage production is held to high standards of safety, from personnel and practices to preparation and packaging. Not only can downtime in F&B cost thousands of dollars per line per hour, it can also result in significant food waste. Overlaying the entire operations are production schedules that factor in added or extended shifts, maintenance, cleaning and sanitation, while assuring minimal downtime.
Preventing lost time and safety issues may not be top-of-mind when selecting products. That is why ABB works with F&B manufacturers to help maximize safety and uptime. ABB leverages expertise across the entire food and beverage processing spectrum to help support plan development and focus on matching the correct product to the correct application.

ABB Applications Solutions

Depending on the nature of their business, F&B industrial buildings include a mix of different processes and equipment with greatly varying power protection requirements.

They have been categorized into the following classes of loads and are protected separately but in a centralized way:



1. Process loads
requires continuous operation, protection against outage and power quality problems.

2. Process Control loads
requires continuous operation, protection against outage and power quality problems in order to support process automation needs and equipment reliability.

3. Critical loads
requires 24/7 continuous operation, protection against outage and abnormal supply conditions in order to support security, personnel safety and reliability.

4. Non Critical loads
Loads that can trip or fail and then restart without impacting plant performance, do not need protection against power outage and can be separated.

ABB Applications Solutions

Power Quality solutions for Process load

To prevent tripping and failure of critical processes, ABB offers a complete solution able to provide clean power free from Power Quality events such as voltage sags, under/over-voltage and outages.

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Emax 2

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Emax 2 catalog

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PCS

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PCS100 AVC-40 catalog

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PCS100 AVC-20 catalog

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PCS100 UPS-I catalog

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Ekip UP

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Ekip UP catalog

The solution includes:

Upstream CB

- PQ equipment protection
- Individual process protection

Product	Rated current
Tmax XT	Up to 1600 A
Emax 2	>1600 A

Metering & Monitoring

- PQ monitoring
- Process energy metering

Product	ABB smart CB	Old or 3rd party CB
Tmax XT	●	-
Ekip UP	-	●

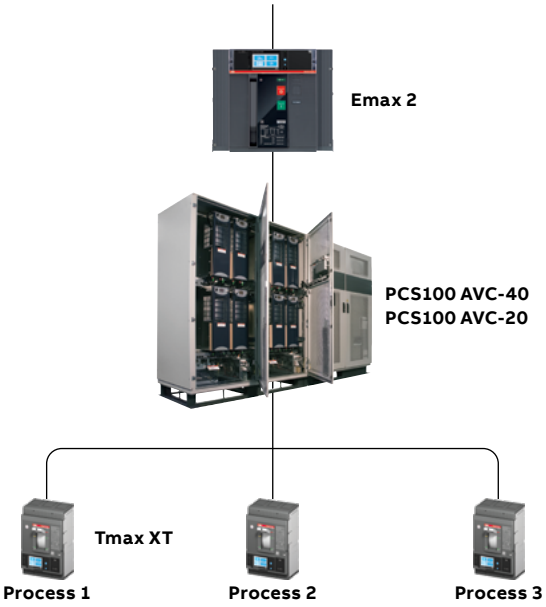
PQ conditioning & protection

- Voltage protection (AVC)
- Voltage protection + backup time (UPS-I)

Product	Sags/ swells	Undervoltage/ overvoltage	Deep sags (<50%)(1)+ Backup time for outages
PCS100 AVC-40	●	-	-
PCS100 AVC-20	-	●	-
PCS100 UPS-I	-	-	●

(1) Based on AVC-40 performance during three phase events.
In single phase sag events, AVC-40 can start correction from 30% remaining voltage.

ABB solutions



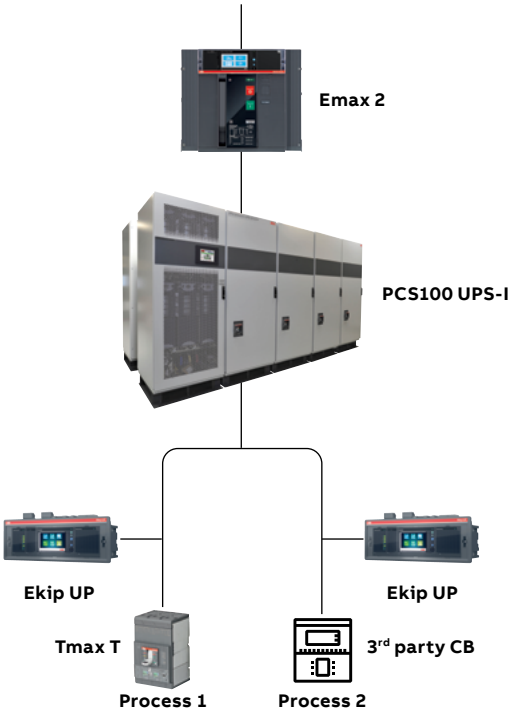


ABB Applications Solutions
Power Quality solutions for Process load

Application tables

The tables below provide the most relevant electrical data required for site planning and an upstream protection device able to ensure the PQ equipment functions correctly, thereby guaranteeing a highly reliable solution in addition to suitable protection for the equipment and, consequently, the process load.

PCS100 AVC-40 (400V Model)

Rated Power (kVA)						Upstream protection		
Rated Power (kVA) @400V, 415V	Rated Power (kVA) @380V	Rated input Current (A)	Rated output Current (A)	Fault capacity (kA)	AVC Type code	Device	Type	Rated current
150	142	253	217	15	PCS100-07-400-0B5-40-x	MCCB	Tmax XT5 N	400
225	213	377	325	15	PCS100-07-400-0B75-40-x	MCCB	Tmax XT5 N	400
300	285	498	431	15	PCS100-07-400-01B-40-x	MCCB	Tmax XT5 N	630
450	427	742	650	31.5	PCS100-07-400-01B5-40-x	MCCB	Tmax XT7 S	800
600	570	985	867	31.5	PCS100-07-400-02B-40-x	MCCB	Tmax XT7 S	1000
750	712	1232	1083	31.5	PCS100-07-400-02B5-40-x	MCCB	Tmax XT7 S	1250
900	855	1474	1300	31.5	PCS100-07-400-03B-40-x	MCCB	Tmax XT7 S	1600
1200	1140	1962	1733	40	PCS100-07-400-04B-40-x	ACB	Emax 2.2 B	2000
1500	1425	2448	2166	50	PCS100-07-400-05B-40-x	ACB	Emax 2.2 N	2500
1800	1710	2932	2599	63	PCS100-07-400-06B-40-x	ACB	Emax 4.2 N	3200
2400	2280	3938	3465	65	PCS100-07-400-08B-40-x	ACB	Emax 4.2 S	4000
3000	2850	4922	4331	65	PCS100-07-400-10B-40-x	ACB	Emax 6.2 H	5000
3600	3420	5906	5197	65	PCS100-07-400-12B-40-x	ACB	Emax 6.2 H	6300

PCS100 AVC-20 (380V & 400V Model)

Rated Power (kVA)	Rated Real power (kW)						Upstream protection		
	Utility Voltage 400V, 415V	±15% regulation	±20% regulation	Rated input Current (A)	Fault capacity (kA)	Type code	device	Type	Rated current
400V	250	250	187	361	15	PCS100-28-400-0B5-20	MCCB	Tmax XT5 N	400
	500	500	375	722	15	PCS100-28-400-01B-20	MCCB	Tmax XT7 S	800
	1000	1000	750	1444	31.5	PCS100-28-400-02B-20-x	MCCB	Tmax XT7 S	1600
	1500	1500	1125	2166	31.5	PCS100-28-400-03B-20-x	ACB	Emax 2.2 N	2500
	2000	2000	1500	2887	40	PCS100-28-400-04B-20-x	ACB	Emax 4.2 N	3200
	2500	2500	1875	3609	50	PCS100-28-400-05B-20-x	ACB	Emax 4.2 N	4000
	3000	3000	2250	4331	63	PCS100-28-400-06B-20-x	ACB	Emax 6.2 H	5000

Rated Power (kVA)		Rated Real power (kW)					Upstream protection		
	Utility Voltage 380V	±15% regulation	±20% regulation	Rated input Current (A)	Fault capacity (kA)	Type code	device	Type	Rated current
380V	237	237	177	343	15	PCS100-28-400-0B5-20	MCCB	Tmax XT5 N	400
	475	475	356	686	15	PCS100-28-400-01B-20	MCCB	Tmax XT7 S	800
	950	950	712	1372	31.5	PCS100-28-400-02B-20-x	MCCB	Tmax XT7 S	1600
	1425	1425	1068	2057	31.5	PCS100-28-400-03B-20-x	ACB	Emax 2.2 N	2500
	1900	1900	1425	2743	40	PCS100-28-400-04B-20-x	ACB	Emax 4.2 N	3200
	2375	2375	1781	3429	50	PCS100-28-400-05B-20-x	ACB	Emax 4.2 N	4000
	2850	2850	2137	4114	63	PCS100-28-400-06B-20-x	ACB	Emax 6.2 H	5000

For PCS100 AVC-40 & PCS100 AVC-20

- Please contact ABB if other voltage models are required
- Choice of the downstream CB depends on the number of parallel branches and the size of each branch
- To complete the Type Code: put R for right termination side or L for left termination side instead of x
- To provide discrimination time for downstream protection, AVC- 40 can withstand rated fault capacity for 200ms
- AVC maximum overload capacity in bypass
  - 125% for 10 minutes / 150% for 1 minute / 500% for 1 s / 2000% for 200 ms

PCS100 UPS-I (400V Model)

PCS100 UPS-I (400V model)						Upstream protection		
Rated Power (kVA)	Inverter rated current (A)	Num. of Modules	Utility disconnect rated current	Fault current (kA) / Withstand capacity (ms)	Type code	device	Type	Rated current
150	217	1	900	25 / 10	PCS100-12-400/50-01-L	MCCB	XT4 N	250
300	433	2	900	25 / 10	PCS100-12-400/50-02-L	MCCB	XT5 N	630
450	650	3	900	25 / 10	PCS100-12-400/50-03-L	MCCB	XT7 S	800
600	866	4	900	25 / 10	PCS100-12-400/50-04-L	MCCB	XT7 S	1000
750	1083	5	2200	50 / 120	PCS100-12-400/50-05-R	MCCB	XT7 H	1250
900	1299	6	2200	50 / 120	PCS100-12-400/50-06-R	MCCB	XT7 H	1600
1200	1732	8	2200	50 / 120	PCS100-12-400/50-08-R	ACB	Emax 2.2 N	2000
1500	2165	10	2200	50 / 120	PCS100-12-400/50-10-R	ACB	Emax 2.2 N	2500
1800	2598	12	4200	65 / 120	PCS100-12-400/50-12-R	ACB	Emax 4.2 N	3200
2100	3031	14	4200	65 / 120	PCS100-12-400/50-14-R	ACB	Emax 4.2 N	3200
2400	3464	16	4200	65 / 120	PCS100-12-400/50-16-R	ACB	Emax 4.2 N	4000
2900	4186	20	4200	65 / 120	PCS100-12-400/50-20-R	ACB	Emax 6.2 H	5000

- Overload ratings (Inverter) 110% of rated current for 30 seconds
- Overload ratings (Utility Disconnect)
  - 120% of rated current for 60s every 10 minutes,
  - 150% of rated current for 30 s every 10 minutes,
  - 200% of rated current for 10 s every 10 minutes,
  - 300% of rated current for 5 s every 10 minutes.

Note: The selection of the right power conditioning solution changes from site to site, depends on the utility network reliability, the process criticality and the financial losses compared to the size of investment. For more information, please check our application note.

ABB Applications Solutions
Continuous Power for Process Control loads

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SOC

Process control loads require continuous operation, as well as protection against outage and power quality problems in order to support process automation needs and ensure the reliability of equipment such as PLCs & DCS.
Outage affects process automation to a considerable extent and restoring the original conditions often takes hours. A continuous supply of electrical power via UPS is therefore critical for the industry. Automation interruptions may lead to downtime within manufacturing and industrial operations. In a food and beverage plant, this downtime can cost between $100,000 and $1 million per hour. A clean continuous power supply is therefore critical for the industry.

Selectivity is also an important parameter. Consider a fault between two circuit breakers (or any other protection device) connected in a series, where the breaker closer to the fault trips without tripping the upstream breaker. To isolate the fault and maintain continuous supply for other loads that are not directly connected to the fault, selectivity must be achieved between circuit breakers, otherwise there is no use in installing a UPS system. As shown in the figure below, a UPS can be installed to protect all critical loads or to protect a specific critical load. (e.g. a DCS).

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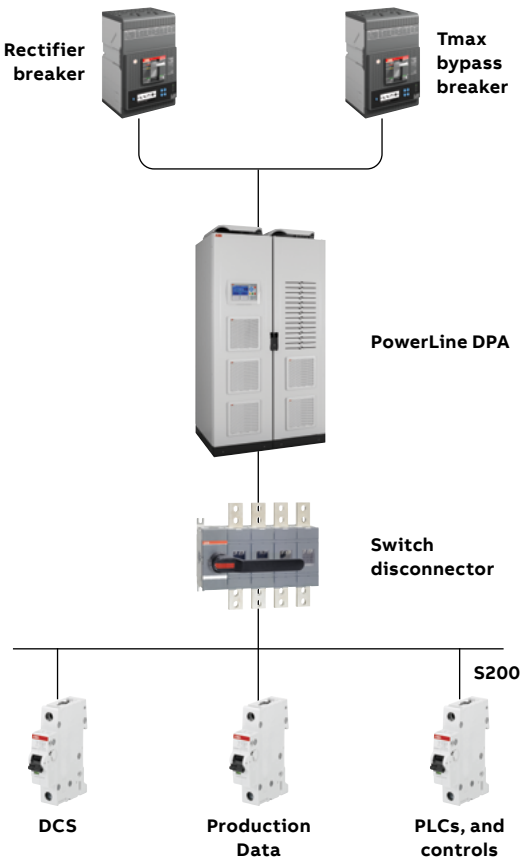
Example of an SLD For Process Control Loads



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PowerLine DPA

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PowerLine DPA Catalog

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Tmax XT

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Tmax XT Catalog

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OT

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S200

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S800

Main Components:

- **UPS:** Modular PowerLine DPA
- **Upstream Breakers:** Tmax XT (MCCBs)
- **Downstream Breakers:** S200 /S800 (MCB)s
- **Switch Disconnector:** OT Switch Disconnector.

Why PowerLine DPA ?

PowerLine DPA (3ph and 1ph) is an on-line double conversion UPS that renders the advantages of ABB's unique modular UPS architecture available for locations that are usually rough on electronic equipment. PowerLine DPA is based on ABB's Decentralized Parallel Architecture (DPA) and ensures the very best UPS design in terms of availability, service ability, safety and ease of use.

Sturdily built, it is suitable for industrial plant environments with a variety of temperatures, dust, moisture and corrosive contaminants.
PowerLine DPA is designed for a 15-year design life. Tailored for industry and process control loads, its pre-configured options ensure agile implementations with short lead times.
Find your way around selectivity when adopting UPS and circuit breakers using ABB building blocks for selectivity. The table below contains useful information about selectivity.
It gives all the nominal characteristics of the selected UPS, together with all the relevant information about the required circuit breakers and switch disconnectors to make it easier for you to match them together and achieve selectivity.

Application Table
PowerLine DPA

UPS Power rating (kVA)	CB Type (Bypass)	CB Type (Rectifier)	Switch Disconnector (optional)	CB Type (Downstream)	Selectivity with upstream bypass	Selectivity with upstream rectifier
20	XT5 N 630 Ekip Dip R 400	XT5 N 630 Ekip Dip R 400	OT160	S203 B 10A	up to 0,7 kA	Up to 70kA
40	XT5 N 630 Ekip Dip R 400	XT5 N 630 Ekip Dip R 400	OT160	S203 B 25A	up to 1,5kA	Up to 70kA
80	XT5 N 630 Ekip Dip R 630	XT5 N 630 Ekip Dip R 630	OT250	S203 B 63A	up to 4kA	Up to 35kA
120	XT5 N 630 Ekip Dip R 400	XT5 N 630 Ekip Dip R 400	OT200	S803 B 80A	up to 5kA	Up to 100kA

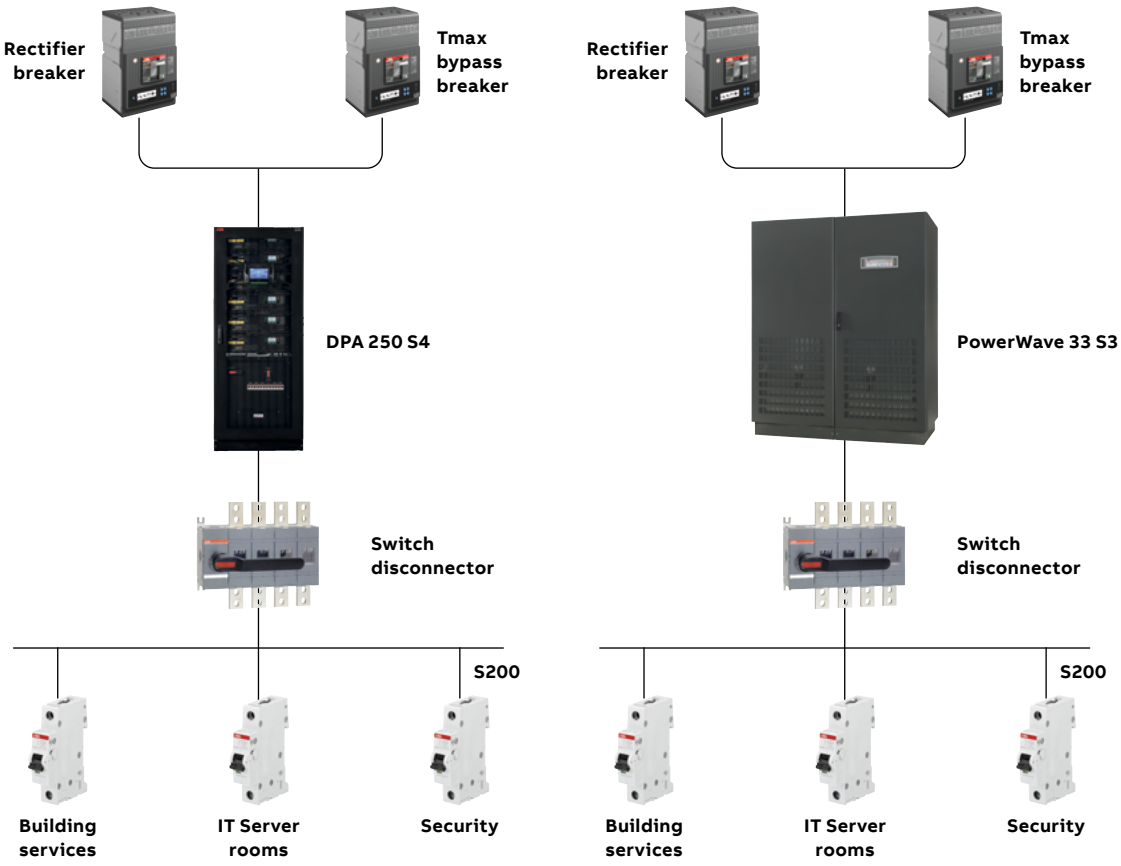
Note: Ekip Touch/Hi-Touch can be used instead of Ekip Dip.

ABB Applications Solutions
Continuous Power for Critical loads

Critical loads are backed up by an independent source of the normal utility supply. These loads must endure abnormal electrical supply conditions if they are to support personnel and food safety, reliability,and security.
This means that critical loads require 24/7 continuous operation besides protection against outage and abnormal supply conditions.

For example, building services, IT server rooms, emergency lighting, security systems, access control systems, Fire Alarm systems, Building Management Systems (BMS), etc., are all critical loads.
As shown in the figure below, the UPS can be installed to protect all critical loads, or to protect a specific critical load (e.g. the IT server room).

Example of an SLD For Critical Loads



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DPA 250 S4

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DPA 250 S4 Catalog

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PowerWave 33 S3

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PowerWave 33 S3 Catalog

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Tmax XT

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Tmax XT Catalog

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OT

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S200

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S800

Main Components:

- **UPS:** Modular DPA 250 S4 / Standalone Powerwave 33 S3
- **Upstream Breakers:** Tmax XT (MCCBs)
- **Downstream Breakers:** S200 /S800 (MCBs)
- **Switch Disconnector:** OT Switch Disconnector

Why DPA 250 S4?

DPA 250 S4 features a modular architecture that offers the best reliability for environmentally conscious organizations that also need zero downtime and low cost of ownership. It is designed for critical, complex, high-density computing environments such as building services, security systems and IT server rooms. Scalable from 50 KW up to 1.5 MW with market-leading 97.6% efficiency for the UPS module. This high efficiency reduces operational costs and minimizes environmental impact. Cuts energy losses by 30% compared to similar products in the market.

Why Powerwave 33 S3?

Powerwave 33 S3 is an on-line double conversion standalone UPS. It delivers continuous power availability to network critical infrastructures making it perfect for building services, emergency lighting, security systems, IT server rooms and facilities. Although it offers maximum power protection, PowerWave 33 has a small footprint and uses less energy than comparable products - thus ensuring significant savings. It is is available in a 60kW to 500kW model range and can be configured to operate as a single, standalone UPS or as a multicabinet UPS system with up to ten UPS cabinets connected in parallel, thereby achieving up to 5MW total power capacity.

Find your way around selectivity when adopting UPS and circuit breakers using ABB building blocks for selectivity. The tables below contain useful information about selectivity.

They give the nominal characteristics of the selected UPS, together with all the relevant information about the required circuit breakers and switch disconnectors to make it easier for you to match them together and achieve selectivity.

Application Table

DPA 250 S4

UPS Power rating (kW)	CB Type (Bypass)	CB Type (Rectifier)	Switch Disconnector (optional)	CB Type (Downstream)	Selectivity with upstream bypass	Selectivity with upstream rectifier
50	XT3 N TMD 200A/ XT4 N ELT 250A	XT1 N TMD 160A/ XT2 N ELT 100A	OT160/OT250 (1)	S203 B 25A	Up to 0.6kA	Total
100	XT3 N TMD 200A/ XT4 N ELT 250A	XT3 N TMD 200A/ XT4 N ELT 250A	OT250	S203 B 25A	Up to 1,75kA	Total
150	XT5 N Ekip Dip R 320	XT5 N Ekip Dip R 320A	OT315	S203 B 63A	Up to 2,5kA	Total
200	XT5 N Ekip Dip R 400	XT5 N Ekip Dip R 400	OT400	S203 B 63A	Up to 4,2kA	Total
250	XT5 N Ekip Dip R 630	XT5 N Ekip Dip R 630	OT630	S203 B 63A	Up to 6,8kA	Total
300	XT5 N Ekip Dip R 630	XT5 N Ekip Dip R 630	OT630	S203 B 63A	Total	Total

1) OT250 for XT3 MCCB.
Note: Ekip Touch/Hi-Touch can also be used instead of Ekip Dip.

PowerWave 33 S3

UPS Power rating (kW)	CB Type (Upstream)	Selectivity with upstream rectifier	Switch disconnector (optional)	CB Type (Downstream)	Selectivity with upstream bypass	Alternative downstream breaker
60	XT1 N TMD R 160/ XT2 N Ekip Dip 100	Total	OT125/OT100	S203 B 40A	Up to 8.5kA	Total with S803 B 16A/ S203 B 16A
80	XT2 N Ekip Dip R 160	Total	OT125	S803 B 63A	Up to 28.5kA	Total with S803 B 32A/ S203 B 40A
100	XT3 N TMD 200/ XT4 N Ekip Dip R 250	Total	OT250/OT160 (1)	S803 B 50A/ S203 B 50A	Total	-
120	XT5 N TMA/ Ekip Dip R 400	Total	OT315	S803 B 63A/ S203 B 63A	Total	-

1) Maximum size of downstream breaker to achieve the selectivity level indicated in table. OT250 for XT3 CB and OT160 for XT4.
Note: Ekip Touch/Hi-Touch can be used instead of Ekip Dip. You can use the same suggested breaker, if 2 upstream breakers are installed (Bypass & Rectifier).

ABB Applications Solutions
Continuous Power for Critical loads

Please remember

- The standalone UPS is monoblock with a single rectifier and bypass line. You lose backup power if one of the 2 lines fails.
- The modular UPS comprises several independent modules. If one module fails, the other module(s) continue to work. If redundancy is required, you can save space thanks to the easy N+1 or N+X redundancy configuration. It also allows for expansion as power requirements increase.
- The UPS rating can be sized to suit the critical loads connected downstream of the UPS and their power rating (Watt = VA x Power factor). Here are some simple steps to help you calculate your UPS rating:
  - Make a note of all the loads (DCS, Server Cabinets, Workstations etc..) as a whole VA or Watt.
  - Specify your feeder location and redundancy requirement.
  - Add all the UPS loads in the same zone and the required battery back up (e.g. select all the loads in the main control room that need 30 minutes of UPS backup).
  - Check whether the loads can be distributed over 1 or more UPS systems.
  - Consider the future extension capacity.
  - Perform an adequacy check of the UPS for the single largest load with crest factor. Make sure that the UPS is able to withstand the biggest inrush current.
- For the circuit breaker settings:
  - Overload Zone : The upstream circuit breaker and overload protection inside the UPS, and the downstream circuit breaker must trip faster (taking into account the tolerances and the real currents circulating in the circuit breakers).
  - Short Circuit Zone :
    - If the upstream circuit breaker is thermo-magnetic, the magnetic threshold must be set to maximum value if it is adjustable (TMA).
    - If the upstream circuit breaker is electronic, set instantaneous protection function I to OFF.

For further information please consult our training module “Selectivity in low voltage UPS distribution networks” on ABB MyLearning (Code : 9CSC017718-GLB-EN).

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ABB MyLearning

ABB Applications Solutions

Power Quality for Point of Common Coupling & Non Linear loads

M4M20

M4M30

Emax 2

Emax 2 catalog

Tmax XT

Tmax XT Catalog

ABB offers solutions that provide real-time metering and monitoring information able to describe the PQ profile of loads or overall facility performance.

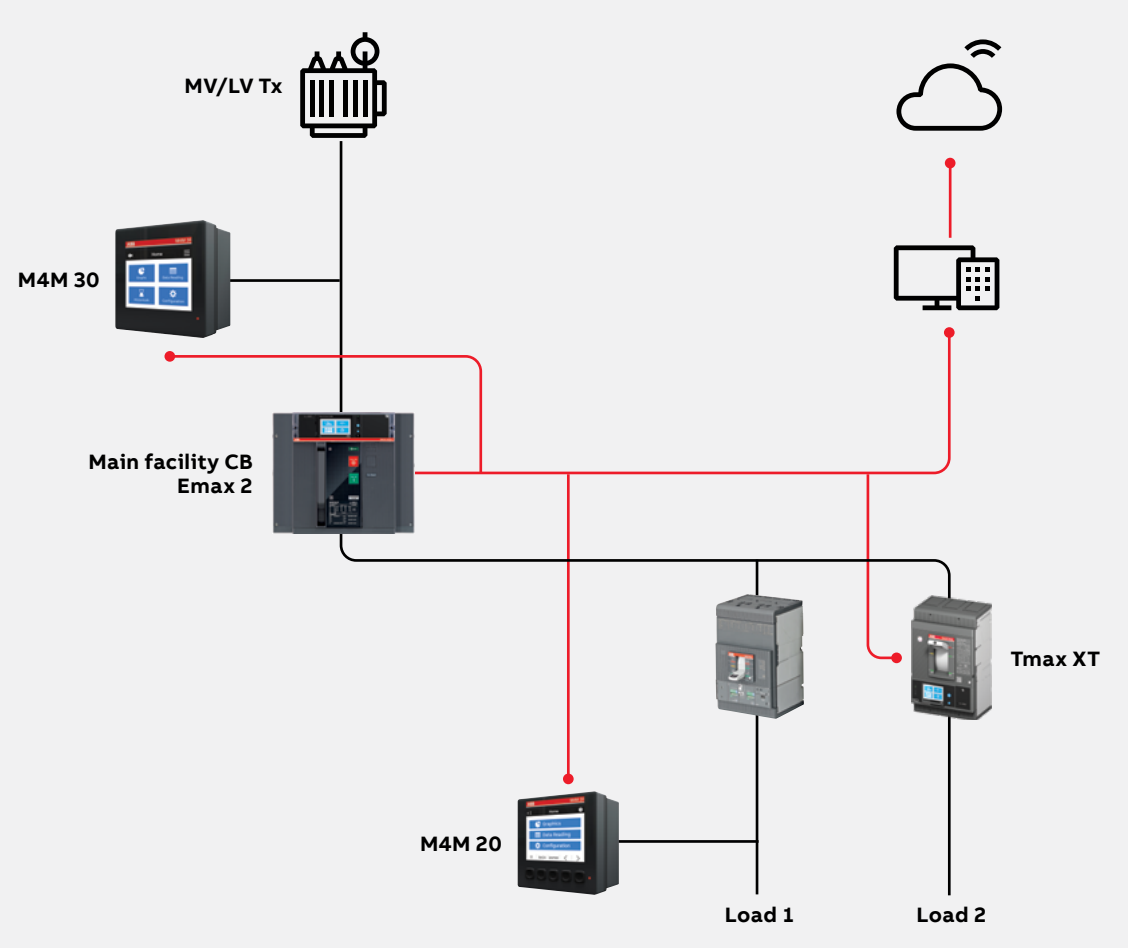
The solution includes:

PQ monitoring & Energy metering

- M4M20
- M4M30
- Tmax XT
- Emax 2

Upstream circuit breaker for load protection

Product	Rated current
Tmax XT	Up to 1600 A
Emax 2	>1600 A



Additional Information
Power Quality Monitoring

Embedded network analyzer (Emax 2/ Tmax XT/ Ekip UP)

The embedded network analyzer monitors power and detect power anomalies eliminating the need for dedicated expensive instrumentation. All the following parameters are continuously monitored:

- Harmonic analysis (up to 50th harmonic)
- Hourly average voltage values
- Short voltage interruption
- Short voltage spikes
- Slow-voltage sags and swells
- Voltage imbalance

Tmax XT/Emax 2 embedded Network Analyzer
The Network Analyzer function continuously monitors energy quality and presents the results on a display or via a communication module.

PQ functionality	
Harmonic analysis	real-time availability of the harmonic content of voltages and currents (measured to the 50th harmonic), as well as the total harmonic distortion value (THD).
Hourly average voltage values	the positive sequence voltage is compared with the limits. If the limits are exceeded, the network analyzer generates a signaling event. The number of these events is stored in a suitable counter. The counter values are available for each of the last 7 days, as well as the total.
Voltage sags & swells	when the voltage strays beyond a range of acceptable limit values for longer than the set time, the network analyzer generates an event that is counted. Three values can be configured for voltage sags and two for voltage swells, each associated with a time limit. This allows the voltage to be monitored to find out whether it remains within a curve of values that are acceptable to equipment such as computers.
Voltage unbalance	the unbalance that occurs when the voltage values are not equal or when the phase displacements between them are not exactly 120° is manifested by a negative sequence voltage value. An event is stored and counted if this limit exceeds the set threshold value.

To upgrade the trip units and achieve the required functionality, three different software packages are available for the breakers:

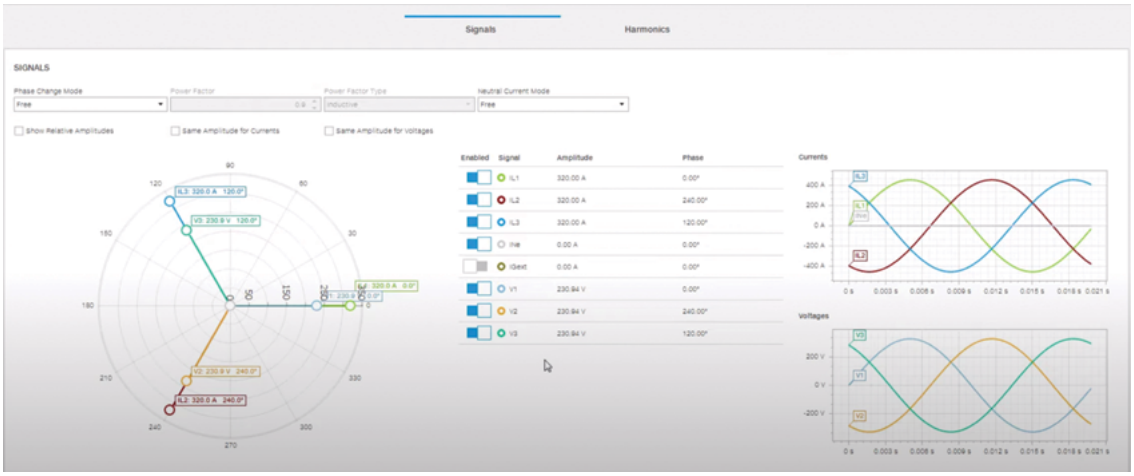
- **Measuring package** for voltage, power and energy measurement
- **Datalogger** for data recording
- **Network Analyzer** for evaluating power quality.

Network Analyzer			**Interval**
Hourly average voltage value	[V] [no]	- Umin= 0.75…0.95 x Un - Umax= 1.05…1.25 x Un - Event counter (1)	t = 5…120min
Short voltage interruptions	[no]	- Umin= 0.75…0.95 x Un - Event counter (1)	t <40ms
Short voltage spikes	[no]	- Umax= 1,05…1,25 x Un - Events counter (1)	t <40ms
Slow voltage sags and swells	[no]	- Umin1= 0.75…0.95 x Un - Umin2= 0.75…0.95 x Un - Umin3= 0.75…0.95 x Un - Umax1= 1.05…1.25 x Un - Umax2= 1.05…1.25 x Un - Event counter (1)	t = 0.02s...60s
Voltage unbalance	[V] [no]	- U neg. seq.= 0.02…0.10 x Un - Event counter (1)	t = 5…120min
Harmonic analysis		Current and Voltage - up to 50th - Alarm THD: 5…20% - Single harmonic alarm: 3...10% plus a count of minutes the harmonic has been exceeded	

Record of values: for each interval with time-stamping		Parameters	Window & interval
Current: minimum and maximum	[A]	I Min, I Max	Fixed synchronizable by remote
Phase-to-phase voltage: minimum and maximum	[V]	U Min, U max	Duration: 5…120min
Active power: average and maximum	[kW]	P Mean, P Max	Number of intervals: 24
Reactive power: average and maximum	[kVAR]	Q Mean, Q Max	
Apparent power: average and maximum	[KVA]	S Mean, S Max	
Data logger: high rate sampling record of parameters		Parameters	
Currents	[A]	L1, L2, L3, Ne, Ig	Fixed synchronizable by remote
Voltages	[V]	U12, U23, U31	
Sampling rate	[Hz]	1200-9600	Duration: 5…120min
Maximum recording duration	[s]	18	Number of intervals: 24
Recording stop delay	[s]	0-10s	
Number of registers	[no]	2 independent	
Info on trip & opening data: after a fault without auxiliary supply		Parameters	
Type of protection tripped		e.g. L, S, I, G, UV, OV	
Fault values per phase	[A/V/Hz w/VAR]	e.g. I1, I2, I3, neutral for S protection V12, V23, V32 for UV protection	
Time-stamping		Date, time and progressive number	

The information could be monitored through a laptop using Ekip Link.

Additional Information
Power Quality Monitoring



Additional Information
M4M network analyzers

M4M 30

Visualization of harmonics (voltage, current) up to 15th on HMI as % of fundamental har-monic. Har-monics up to 40th available via communication.

Power Quality monitoring:
- Demand management
- Electrical monitoring of equipment
- Power Factor management
- Power availability

Measurements	Availability	Accuracy	Note
Currents (RMS) [A] L1, L2, L3, Ne	●	0.2	
Phase-phase voltage (RMS) [V] U12,U23,U31	●	0.2	
Phase-neutral voltage (RMS) [V] U1,U2,U3	●	0.2	
Frequency [Hz] f	●	0.1	
Active power [kW] P1,P2,P3,Ptot	●	0.5	
Reactive power [kVAR] Q1,Q2,Q3,Qtot	●	1	
Apparent power [KVA] S1,S2,S3,Stot	●	0.5	
Power factor PF1,PF2,PF3,PFtot	●	0.5	
Active energy [kW] Ep total, Ep positive, Ep negative	●	0.5	
Reactive energy [kVAR] Eq total, Ep positive, Ep negative	●	2	
Apparent energy [KVA] Es total	●	0.5	
Power Quality	●		Up to 40th harmonic
Sampling frequency			128 samples per cycle

Communication protocols	Availability	Note
Modbus RTU	●	
Modbus TCP	●	
IEC61850		
Profibus-DP	●	
Profinet		
Ethernet / IP		
DeviceNet		
BACnet/IP	●	
Cloud connectivity		
Bluetooth	●	Available in all versions
Ekip Link		
Digital I/O	●	4 programmable I/O(or 6 opt.)
Analog Outputs (4-20mA, 0-20mA)	●	2 optional

OTHER NOTES
Field device integrated in EDCS via cloud gateways
Internal memory (32MB, 1-year of load profiles, max/min demand, energy trends)
Standard CT (5A or 1A) or Rogowski coil acceptance
4 programmable I/O - standard option; 6 programmable I/O and 2 analog outputs (4-20mA / 0-20mA) – extended I/O option

Additional Information
M4M network analyzers

M4M 20

Measurements	Availability	Accuracy	Note
Currents (RMS) [A] L1, L2, L3, Ne	●	0.2	Calculated Ne
Ground fault current (RMS) [A] Ig			
Phase-phase voltage (RMS) [V] U12,U23,U31	●	0.2	
Phase-neutral voltage (RMS) [V] U1,U2,U3	●	0.2	
Frequency [Hz] f	●	0.1	
Active power [kW] P1,P2,P3,Ptot	●	0.5	
Reactive power [kVAR] Q1,Q2,Q3,Qtot	●	2	
Apparent power [KVA] S1,S2,S3,Stot	●	0.5	
Power factor PF1,PF2,PF3,PFtot	●	0.5	
Active energy [kW] Ep total, Ep positive, Ep negative	●	0.5	
Reactive energy [kVAR] Eq total, Ep positive, Ep negative	●	2	
Apparent energy [KVA] Es total	●	0.5	
Power Quality	●		
Harmonics	●	1	THD
Network analyzer	●		
Sampling frequency			1200-2400-4800-9600 Hz

Communication protocols	Availability	Note
Modbus RTU	●	
Modbus TCP	●	
IEC61850		
Profibus-DP	●	
Profinet		
Ethernet / IP		
DeviceNet		
BACnet/IP	●	
Cloud connectivity		
Bluetooth	●	Available on all versions
Ekip Link		
Digital I/O	●	2 Digital outputs (+ 2 programmable I/O opt.)
Analog Outputs (4-20mA, 0-20mA)	●	2 optional

Additional Information
Active Voltage Conditioning (AVC)

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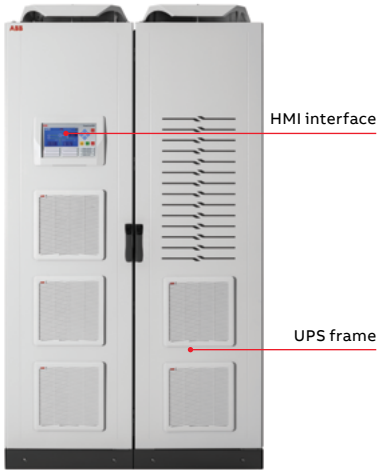
Improving the quality of the power delivered by the grid

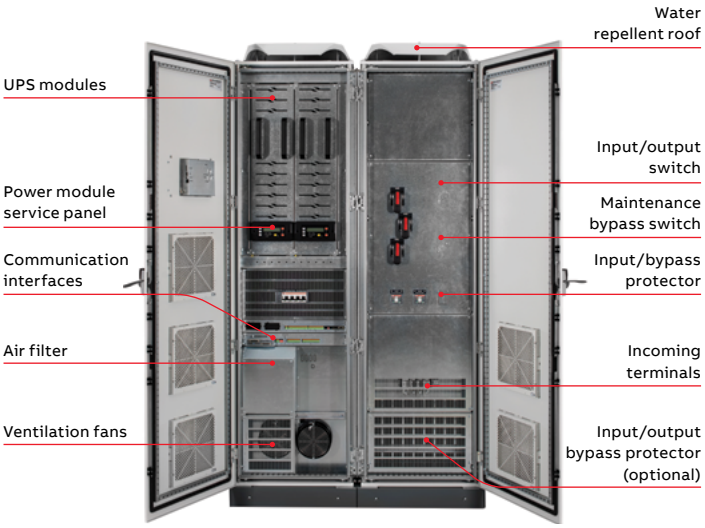
Utility sag and surge correction
PCS100 AVC-40
Active voltage conditioner for sag correction
Power ranges : 150kVA to 3600kVA
Full correction: <10ms
Built on a proven and dependable converter platform, provides instant voltage sag and surge correction, ensuring maximum productivity. It offers +/- 10% constant voltage regula-tion as well as a full correction of 3 phase sags down to 60% remaining voltage.

Load voltage regulation
PCS100 AVC-20
Active voltage conditioner for voltage regulation
Power ranges : 250 kVA to 3000kVA
Full regulation: <20ms
Ensures a continual, regulated supply of utility voltage where the electric infrastructure is stressed, unstable or unreliable. Its constant +/- 20% regulation range secures productivity by improving consistency in operations and reducing the impact of fluctuating voltage on equipment.

All this in addition to:
- Correction of phase angle errors
- Correction of voltage imbalance
- Attenuation of flickers from utility supp.

Additional Information
PowerLine DPA





Features:

Safe
- High overload and short circuit capability
- System-integrated galvanic isolation and step up-down voltage transformers available (optional)
- High capacity battery current charge for long battery banks
- High protection rating: IP31 (standard), IP42 (optional)
- Designed for deployment in demanding industrial situations
- Small foot print /high power density.

High Availability
- Decentralized Parallel Architecture (DPA)
- Modules can be replaced and added without downtime (on-line swappable).

Efficient
- User-friendly operating interface
- Up to 96% overall efficiency
- Fast maintenance
- Full front access
- Reduced spare part inventory.

Sturdy
- Can easily cope with dust, water condensation, excessive humidity (up to 95%), corrosive air contamination and rough manhandling
- -5 to +45 °C operating temperature range.

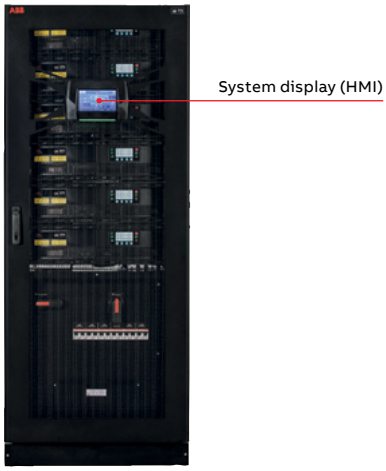
Monitoring

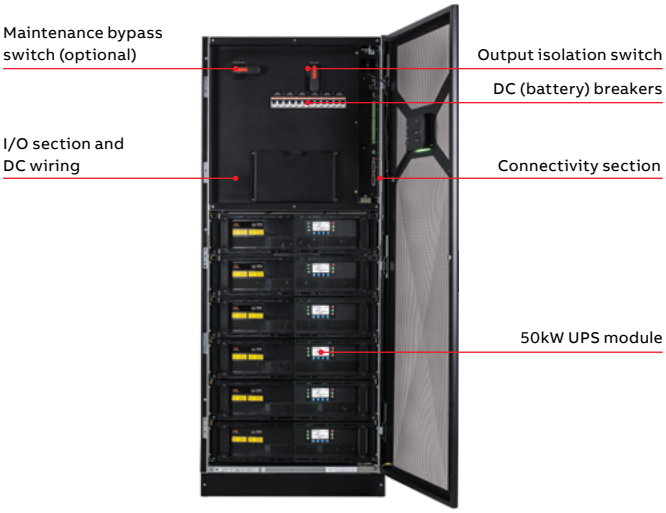
Can be supplied with relay boards and a network management card providing connection to a DCS or SCADA system via SNMP, ModBus TCP or ModBus RS-485. These interfaces allow:
- Environmental monitoring
- Extensive alarm handling and dispatching
- Redundant UPS monitoring
- Integration of PowerLine DPA into multivendor and multiplatform environments
- Supply of UPS data to Web applications.

Battery Bank
- Use VRLA / NiCad / Li-Ion batteries
- Support up to 10h autonomy times.
- Fast recharging.

Standards
- IEC/EN 62040-1 General & Safety
- IEC/EN 62040-2 Electromagnetic compatibility (EMC)
- IEC/EN 62040-3 Performance & Testing
- ISO 9001:2015, ISO 14001:2015, OHSAS18001.

Additional Information
DPA 250 S4





Features:

High Efficiency
- Reduces energy losses by 30% compared to similar products on the market.
- Over 97% energy efficiency in a wide operating range thanks to three-level interleaved technology.
- The Xtra VFI - double conversion mode maximizes efficiency under low-load conditions.

High Availability
- Decentralized Parallel Architecture (DPA).
- Replace or add modules withNO downtime (online swappable).
- Secure ring communication ensures there is no single point of failure in the system.

High Flexibility
- Small footprint saves space and adapts to different installation layouts.
- Variety of options for energy backup, including lithium-ion batteries.
- Powerful battery charger, ready to support the critical load during the next outage.
- Just 10 minutes to withdraw a module and insert it back on-line into the system.

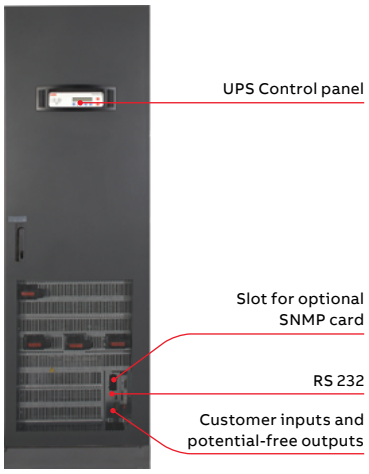
Sturdy
- Very sturdy design featuring practical handles (e.g. mechanical stoppers to prevent the modules from sliding out too far).
- 0 to +40 °C operating temperature range.

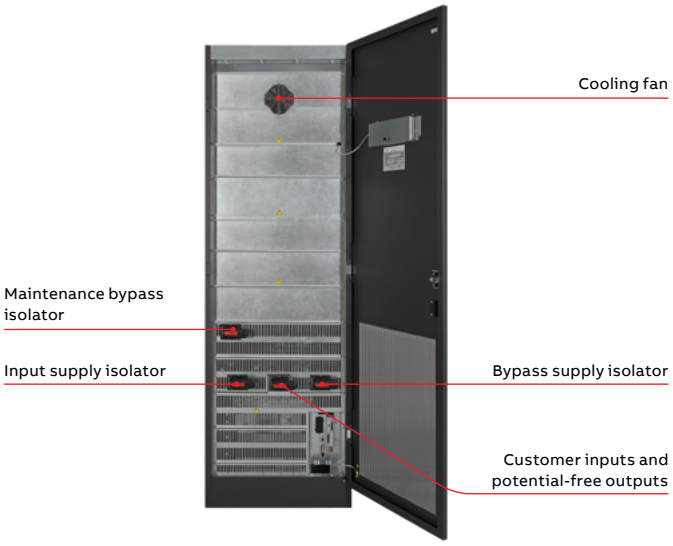
Monitoring
- Easy monitoring at system and module level
- ABB Ability™ SmartTracker.
- Communication interfaces: RS-232 and USB ports, I/O dry contacts (EPO, GEN On, ...) and interface for external key interlock (bypass).
- Control and monitoring (ModBus RS-485, ModBus TCP/IP, SNMP and others).

Battery Bank
- Uses VRLA / Open Cells /NiCad / Li-Ion batteries.
- Fast recharging.

Standards
- IEC/EN 62040-1 General & Safety
- IEC/EN 62040-2 Electromagnetic compatibility (EMC).
- IEC/EN 62040-3 Performance & Testing.
- ISO 9001:2015, ISO 14001:2015, OHSAS18001.

Additional Information
PowerWave 33 S3





Features:

High reliability
- On-line double conversion technology.
- Parallelable systems for increased redundancy.
- Extendable backup time.
- Ripple-free and temperature controlled battery .
- Chargers extend battery life time performance.

Compact
- Small footprint saves expensive floor space.
- Cooling air exhausted through the top of the cabinet. No rear cabinet clearance is required (only 60-120kW and 400 to 500kW units).

Efficient
- Up to 96% efficiency in double conversion mode across a wide load range.
- Up to ≥99% efficiency in eco-mode.
- 1.0 rated output power factor.
- User-friendly LCD.
- Remote monitoring and connectivity options.

Sturdy
- Parallel configuration of up to 10 units with system power up to 5 MW.
- IP 20 protection (must be kept indoors, away from liquids).
- 0 to +40 °C operating temperature range.

Battery
- Uses sealed, lead-acid, maintenance-free or NiCd batteries.
- External battery cabinet.
- Battery temperature sensor.

Standards
- IEC/EN 50171 Central Power Supply Systems.
- IEC/EN 62040-1 General & Safety.
- IEC/EN 62040-2 Electromagnetic compatibility (EMC).
- IEC/EN 62040-3 Performance & Testing.
- ISO 9001:2015, ISO 14001:2015, OHSAS18001.

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