APPLICATION GUIDE

Continuous Power for UPS networks' selectivity in Data Centers

IEC

Data Center UPSes are crucial for continuity of service and power factor correction, but using them without a proper selectivity chain could lead to unwanted downtime as well as financial and physical damage.

What is Continuous Power?
Continuous Power is everything in terms of products and functionalities in installations tasked with supplying energy, protecting people and loads. ABB cutting edge solutions achieve fast coordination between devices, thus avoiding stress and damage to the electrical distribution system by excluding only the minimum zone affected by the fault.

Why you need Continuous Power solutions
Data Centers are coordinated, optimized facilities built as intelligent, highly efficient and highly reliable systems. Selectivity is the key to establishing a good system in facilities that cannot tolerate power cuts in their Data Centers. This is because selective systems isolate faults within the shortest time, with the minimum damage and ensure that the least number of unrelated loads is affected by the fault. It is well known that outages in Data Centers can have a huge impact due to loss of data, corrupted files, ruined equipment, reputational damage, etc. When there are immeasurable losses, costs cannot be predicted precisely because they are strongly related to where the error occurred and how long it took to be eliminated. This application explains how to correctly design selectivity in configurations with a UPS, thereby ensuring that it will not be excluded from the network if a fault occurs but safely continue to feed loads of paramount importance. Let us carry the load!

Main benefits

Continuity of service
This tool aims to provide everything needed to boost system reliability

Pre-engineered solutions
Leverage on ABB expertise for selectivity in your facility

Introduction

After global awareness of the effects of the COVID-19 pandemic, the importance of digitalization became crystal clear. Modern society and businesses began relying on data centers as never before. Growing dependence on such facilities and the need to assure zero-downtime in data center operations means that each tiny detail of data center design becomes of the utmost importance and has to be carefully managed.

The reliability of electrical distribution infrastructure in data centers must be treated as one of the key design factors if high availability is to be assured. Owing to their sensitive nature, IT loads need clean and continuous power supplied through a UPS. This means that selectivity coordination of different protection devices (upstream and downstream of the UPS) during faults plays a vital role in increasing the availability of the electrical network.

The purpose of this Application Note is to illustrate the way that ABB UPSes function together with what is called the “Site Planning Tool”: a collection of coordination tables and technical information to support customers in designing, setting and installing the chosen UPS and its protection devices. It also contains information about how to design the protection settings and correctly size and choose the general DC circuit-breaker of the UPS battery cabinets.

Double Conversion UPS topology

Depending on application requirements, different types of UPS systems are available on the market including standby, line-interactive and double conversion UPSes.

The protection philosophy must be designed to suit the type of UPS and system configuration. This paper focuses on low voltage double conversion UPSes as they are the type most often used in data centers worldwide.

Double conversion UPSes (as indicated by the name itself, this type of UPS converts twice – AC to DC and DC to AC) ensure complete isolation through the DC bus between the output of the UPS system connected to the loads and the input grid, which may be affected by power quality problems, such as voltage or frequency disturbances. Typically, double conversion UPSes meet VFI (Voltage Frequency Independent) performance classification requirements as laid down by IEC 62040-3. It means that the load supply is independent of frequency and voltage variations in the supply network.

In this configuration, the UPS would be able to accept three different power sources:

1. The First Source is the utility, which acts as a main power source and supplies power to the battery charging source as well as the load via the rectifier/ inverter combination.
2. The Second source is the battery itself, which provides power instantaneously during transient events at the input side and provides bridging time until the generator starts (usually within the range of minutes).
3. The Third source is a generator, which provides backup during outages (usually within in the range of hours).

Loads can be supplied through a static bypass if minimum possible losses are targeted, but in this operating mode the load is exposed to voltage and frequency variations in the supply source (VFD Voltage Frequency Dependent) . The other case in which a static bypass switch supplies power to the load is during abnormal conditions such as short-circuits.

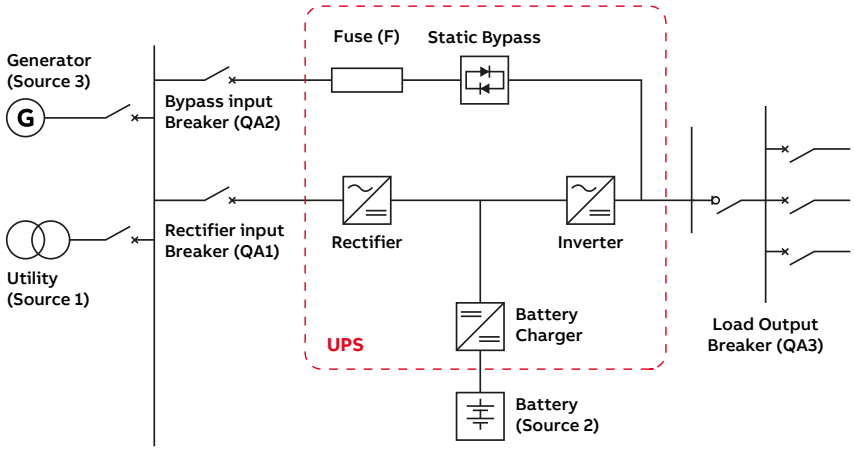
Knowing the different power sources and UPS operating modes is imperative if the right protection layout is to be dimensioned and the correct protection devices selected.

To provide a complete overview before examining the selectivity topic, another important aspect, i.e. the available input configuration, will be considered in the next section.

Dual or Single input feed configurations

ABB UPSes support configurations with dual or single input feeds. This means that the configuration can be as shown in figure 1 (Dual), where one protection device (QA1) is dedicated to protecting the cable from the switchgear to the UPS rectifier bridge while another (QA2) is dedicated to the static bypass.

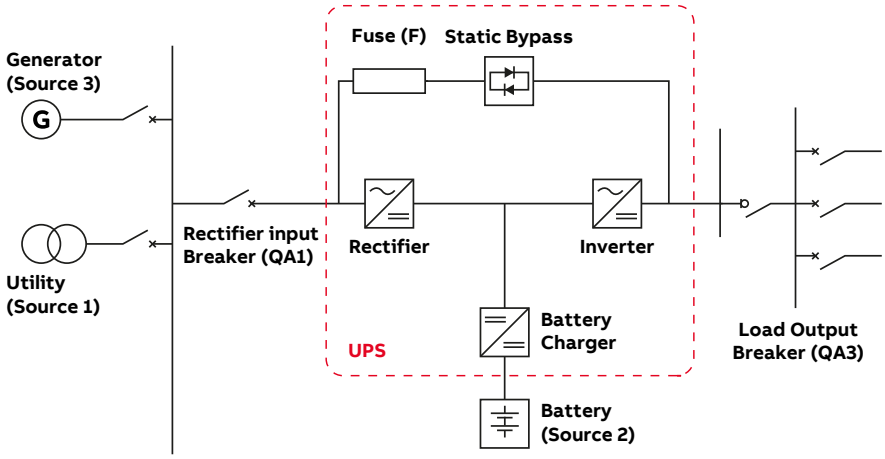
Fig.1
Double Conversion mode
UPS, Double input feed



In the Single input feed configuration, a single protection device protects the same line, feeding both the rectifier and the static bypass. Note that this circuit-breaker (QA2) it shares the same name as the one in the Dual input feed architecture on the bypass.

The coordination tables in the Site Planning tool described further on have been created considering circuit-breaker QA2 for one of the two selectivity chains for modular UPSes, but this will be explained in detail the next sections.

Fig. 2
Double Conversion mode
UPS, Single input feed



UPS Modes of Operation

The main function of the UPS is to provide clean and continuous power to the downstream loads. If the UPS cannot provide clean energy or an adequate voltage level, as specified in IEC 62040-3, it will transfer the load to the static bypass switch.
A UPS represents an additional power source in an electrical network with its own performance/ characteristics, which need to be taken into consideration when the system and protections are designed.
During normal operation, the UPS supplies the load from either:

1. The utility (or Generator) via the rectifier in path 1 of Figure 3.
2. The utility (or Generator) via the static bypass switch to minimize losses (bypass-mode), as shown in path 2 of Figure 3.
3. Via the battery if a utility outage occurs until the generator comes back on-line, as shown in path 3 of Figure 3.

UPS inverter capability on current delivery for downstream short circuits is typically limited to 2-3 times its rated current value, while the static bypass switch is often sized to carry at least 10 times the UPS rated current for a period of 20-100 milliseconds.
During downstream load faults, the load circuit-breaker is required to clear the fault as fast as possible so as to restore the voltage on the output bus and remain within the ITIC (Information Technology Industry Council) requirements of the other IT loads connected.

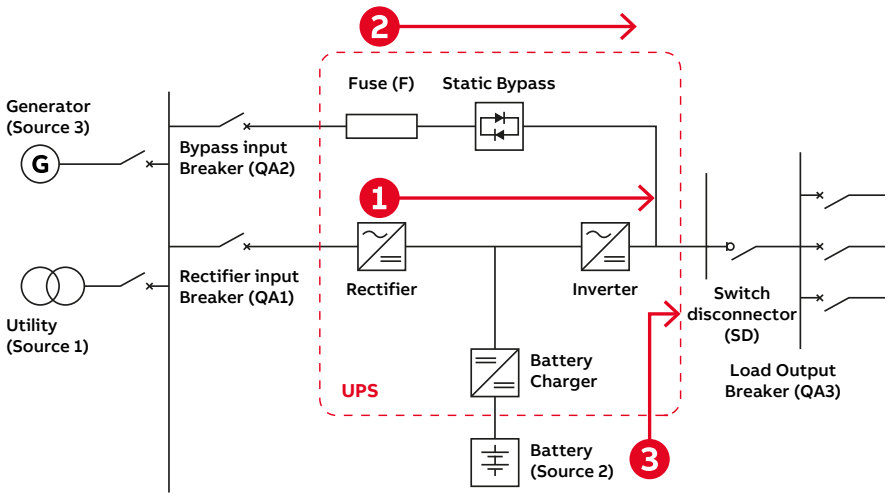


Fig. 3
Current paths during normal operation of Double Conversion UPS, Double Input Feed

Standalone or Modular UPS

ABB can provide both standalone and modular UPSes.

Standalone UPSes are monolithic machines, thus the selectivity chain to be considered is the one between the downstream circuit-breaker (QA3) and the fuse in the internal bypass (F).
On the other hand, modular UPSes leverage Decentralized Parallel Architecture (DPA), which consists of several modules up to the required nominal power of the unit and completely independent of each other (each module has a rectifier – inverter branch and a static bypass). This means that if there is an internal fault in one of the modules and a redundant configuration, the UPS is still able to carry the current with the remaining ones. There are two selectivity chains to be considered in the case of a Modular UPS:

- Load circuit-breaker QA3 with internal static bypass fuse F
- Fuses F of each module with circuit-breaker QA2 (as main input circuit-breaker for single input feed UPSes or as bypass input circuit-breaker for the dual topology).

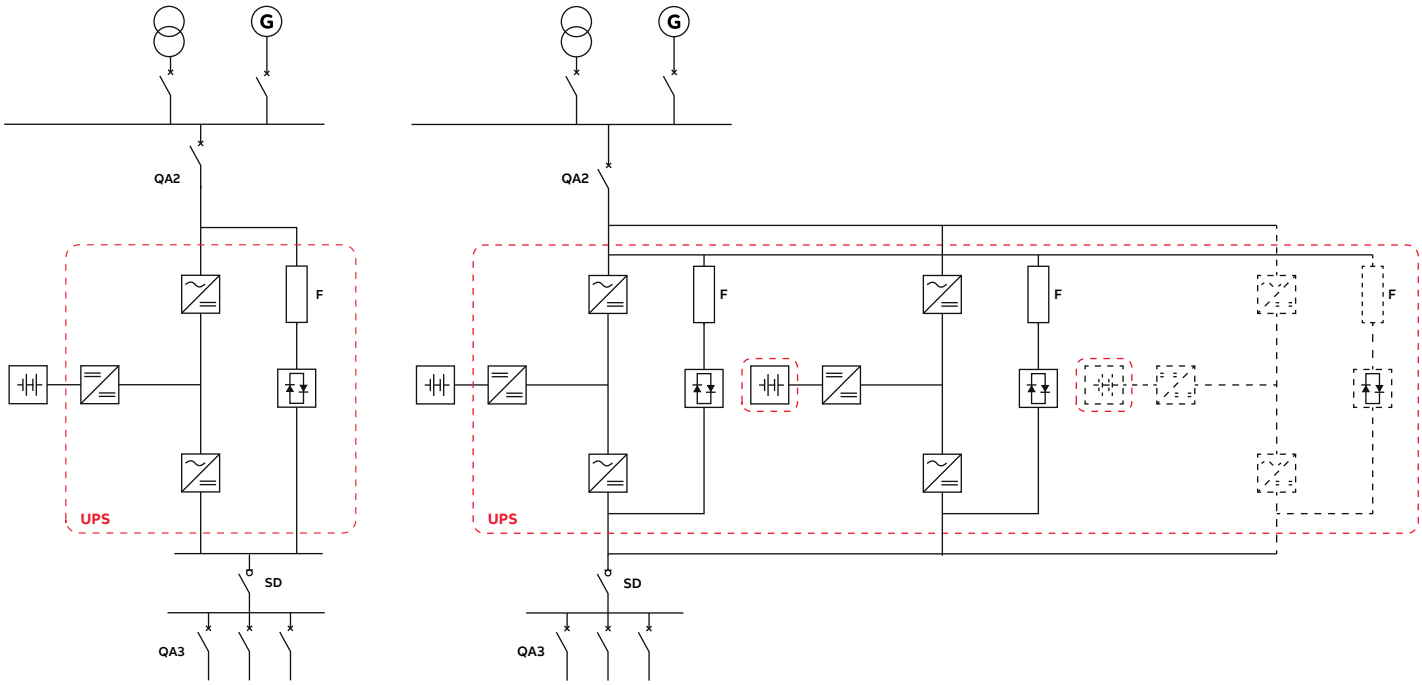


Fig 4
Two UPS layouts, one Standalone (on the left) and the other Modular (on the right)

Sizing considerations for Protection Devices

Factors based on the location of the breaker in the circuit must be considered when circuit-breakers are selected

A few factors to support UPS network design and component selection are described below.

Consider the following when choosing the UPS input breaker (QA1):

- The rated power and overload characteristics of the UPS.
- The battery charging current.
- The UPS input breaker must interrupt prospective short circuits from the most powerful sources (utility transformer).
- It must trip prospective short circuits from the least powerful sources (typically the generator).

Consider the following when choosing the static bypass switch input breaker (QA2):

- The same short circuit withstand rules for QA1 in relation to different power sources also apply to QA2
- It must withstand simultaneous energizing of all loads.

Downstream Load breakers (QA3)

- These breakers must be sized with respect to load requirements for prospective short circuit current at the installation point.

Site Planning Tool

Introduction and User Guide

Having considered the characteristics of ABB UPSes and the information about sizing the protection devices, the next step is to take a look at the pre-engineered tables created by ABB to facilitate installation design by providing clear and univocal indications.

Instructions about how to consult and use the Site Planning Tool are given below.

1. Find your way around different types of UPS

Open the tool and scroll down to the main menu where different UPSes, in terms of technology and size, are listed.

STANDALONE UPSes	MODULAR UPSes
PowerWave 33 S2	DPA 250 S4
PowerWave 33 S3	DPA 500
SG Series	MegaFlex DPA
TLE Series	PowerLine DPA
PowerScale	DPA UPScale ST/RI

2. Find the best match to achieve selectivity

After clicking on the desired UPS, you will be taken to the relative page where you will find a table like the one below.

Nominal Voltage [V]	Number of Modules	UPS Nominal power [kW]	UPS Icw [kA]	Rectifier Circuit-Breaker QA1 (1)	Bypass Circuit-Breaker QA2 (2)	Switch Disconnector SD (3)	Load Circuit Breaker QA3 (4)	Bypass Branch Selectivity F-QA3	Bypass Branch Selectivity QA2-F
400	1	50	10	XT1B 160 TMD 160	XT3N 250 TMD 200	XT3D 250	S203 - B25	Up to 0.6kA	Total
400	2	100	10	XT3N 250 TMD 200	XT3N 250 TMD 200	XT3D 250	S203 - B25	Up to 1.75kA	Total
400	3	150	10	XT5N 400 TMA 320	XT5N 400 TMA 320	XT5D 400	S203 - B63	Up to 2.5kA	Total
400	4	200	10	XT5N 400 TMA 400	XT5N 400 TMA 400	XT5D 400	S203 - B63	Up to 4.2kA	Total
400	5	250	10	XT5N 630 TMA 630	XT5N 630 TMA 630	XT5D 630	S203 - B63	Up to 6.8kA	Total
400	6	300	10	XT5N 630 TMA 630	XT5N 630 TMA 630	XT5D 630	S203 - B63	Total	Total

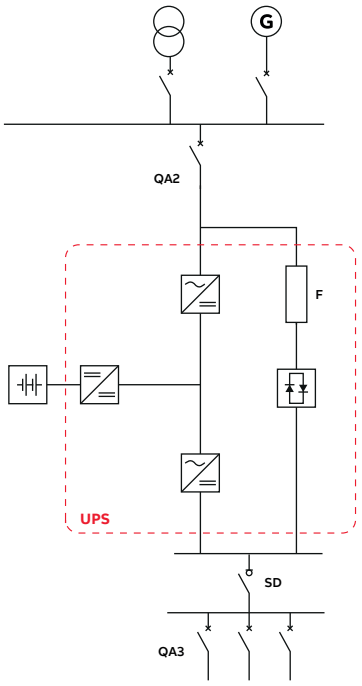
Technical information about the UPSes is given from left to right (**Nominal Voltage, Number of Modules, UPS Nominal Power** and **UPS Icw** columns).
The **Rectifier Circuit-Breaker QA1** column gives the recommended size (e.g. XT1B 160) and rated current (e.g. TMD 160) of the circuit-breaker in the Rectifier - Inverter Branch (if a dual input feed UPS is chosen).
The **Bypass Circuit-Breaker QA2** column gives the recommended size and rated current to be chosen for the circuit-breaker above the UPS static bypass if a dual input feed configuration is chosen, otherwise it will be considered as main and only circuit-breaker for a single input feed configuration.
The **Switch Disconnector SD** column gives the recommended switch-disconnector to install after the UPS: this is not a mandatory requirement, but having it instead of a general circuit-breaker of the same size largely increases the selectivity level achievable between load circuit-breaker and static bypass fuse.
The **Load Circuit-Breaker QA3** column concerns the choice of load circuit-breaker able to provide the Selectivity level given in the **Bypass Branch selectivity F – QA3. column**
The **Bypass Branch Selectivity QA2-F** column gives the achieved selectivity values between bypass input circuit-breaker QA2 and the fuses in parallel for Modular UPSes. Additional information about selectivity rules for both the selectivity chains described here is available in the Annex.

STANDALONE UPSes	MODULAR UPSes
PowerWave 33 S2	DPA 250 S4
PowerWave 33 S3	DPA 500
SG Series	MegaFlex DPA
TLE Series	PowerLine DPA
PowerScale	DPA UPScale ST/RI

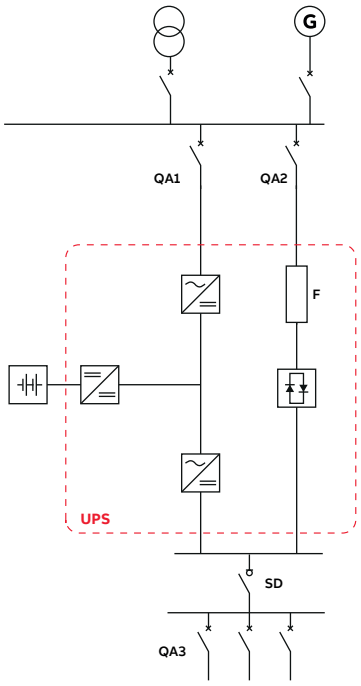
PowerWave 33 S2

Available Configurations

Single Input Feed



Dual Input Feed



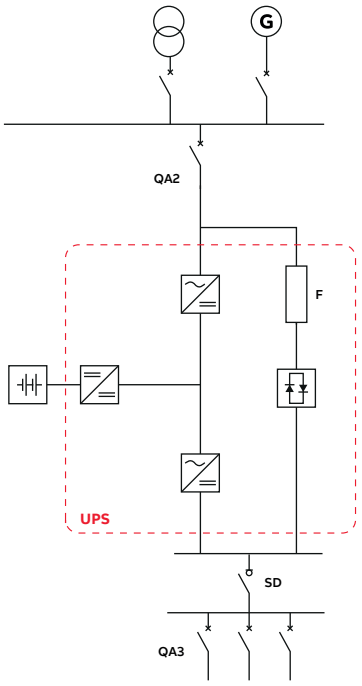
Nominal Voltage [V]	UPS Nominal power [kW]	UPS Icw [kA]	Rectifier Circuit-Breaker QA1 (1)	Bypass Circuit Breaker QA2 (2)	Switch Disconnector SD (3)	Load Circuit Breaker QA3 (4)	Bypass Branch Selectivity F-QA3
400	160	10	XT5N 400 Ekip Dip 400	XT5N 400 Ekip Dip 400	XT5D 400	S203 - B63	Up to 4.2kA
400	200	10	XT5N 630 Ekip Dip 630	XT5N 630 Ekip Dip 630	XT5D 630	S203 - B63	Up to 6.8kA
400	250	10	XT5N 630 Ekip Dip 630	XT5N 630 Ekip Dip 630	XT5D 630	S203 - B63	Up to 6.8kA
400	300	10	XT6N 800 TMA 630	XT6N 800 TMA 630	XT6D 630	XT2N 160 Ekip Dip LSI 160	Total
400	400	10	XT6N 800 TMA 800	XT6N 800 TMA 800	XT6D 800	XT4N 250 Ekip Dip LSI 250	Total
400	500	10	XT7S 1000 Ekip Dip LSI 1000	XT7S 1000 Ekip Dip LSI 1000	XT7D 1000	XT4N 250 Ekip Dip LSI 250	Total

(1) The rated ultimate short circuit breaking capacity (Icu) of the circuit-breakers listed here must be chosen in accordance with the prospective short circuit current at the installation point
(2) The rated ultimate short circuit breaking capacity (Icu) of the circuit-breakers listed here must be chosen in accordance the prospective short circuit current at the installation point. If the configuration is the single input feed type, this is the circuit-breaker to be used for correct electrical dimensioning
(3) Optional device, suggested instead of a circuit-breaker for selectivity purposes
(4) The indicated circuit-breaker provides the selectivity level given in the “Bypass Branch Selectivity F-QA3” column. The rated ultimate short circuit breaking capacity (Icu) of the circuit-breaker indicated here must be chosen in accordance with the prospective short circuit current at the installation point

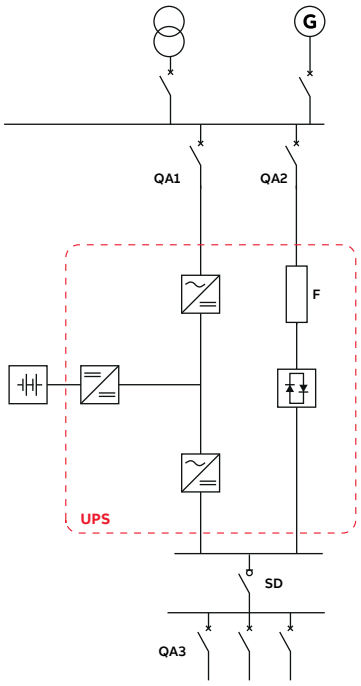
PowerWave 33 S3

Available Configurations

Single Input Feed



Dual Input Feed



Nominal Voltage [V]	UPS Nominal power [kW]	UPS Icw [kA]	Rectifier Circuit-Breaker QA1 (1)	Bypass Circuit Breaker QA2 (2)	Switch Disconnector SD (3)	Load Circuit Breaker QA3 (4)	Bypass Branch Selectivity F-QA3
400	60	10	XT1N 160 TMD 160A	XT1N 160 TMD 160A	OT 125	S203M - B40	Total
400	80	10	XT2N 160 TMA 160	XT2N 160 TMA 160	OT 160	S803 - B50	Total
400	100	10	XT3N 250 TMD 200	XT3N 250 TMD 200	XT3D 250	S803 - B63	Total
400	120	10	XT5N 400 Ekip Dip LSI 250	XT5N 400 Ekip Dip LSI 250	XT5D 400	S803 - B63	Total

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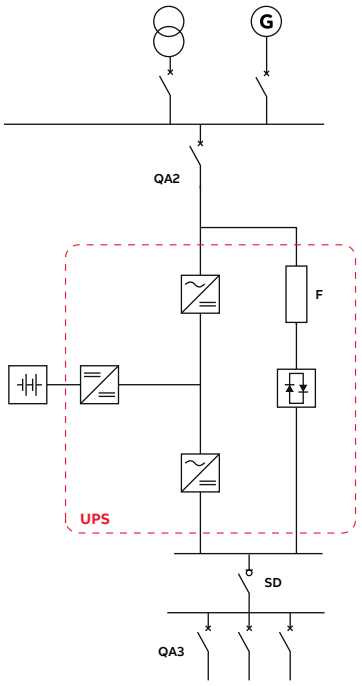
(2) The rated ultimate short circuit breaking capacity (Icu) of the circuit-breakers listed here must be chosen in accordance with the prospective short circuit current at the installation point. If the configuration is the single input feed type, this is the circuit-breaker to be used for correct electrical dimensioning
(3) Optional device, suggested instead of a circuit-breaker for selectivity purposes
(4) The reported circuit breaker is granting the selectivity level displayed in the column “Bypass Branch Selectivity F-QA3”. The rated ultimate short circuit breaking capacity (Icu) of the circuit-breaker indicated here must be chosen in accordance with the prospective short circuit current at the installation point

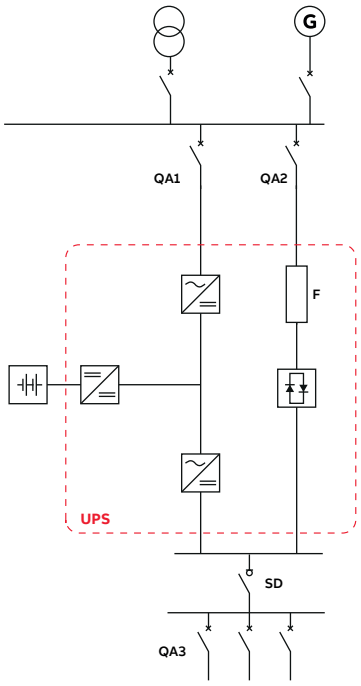
SG Series

Available Configurations

Single Input Feed



Dual Input Feed



Nominal Voltage [V]	UPS Nominal power [kW]	UPS Icw [kA]	Rectifier Circuit-Breaker QA1 (1)	Bypass Circuit Breaker QA2 (2)	Switch Disconnector SD (3)	Load Circuit Breaker QA3 (4)	Bypass Branch Selectivity F-QA3
400	10	10	XT1B 160 TMD 63	XT1B 160 TMD 63	OT63F	S203 - B6	Total
400	15	10	XT1B 160 TMD 63	XT1B 160 TMD 63	OT63F	S203 - B6	Total
400	20	10	XT1B 160 TMD 63	XT1B 160 TMD 63	OT63F	S203 - B6	Total
400	30	10	XT1B 160 TMD 63	XT1B 160 TMD 63	OT63F	S203 - B6	Total
400	40	10	XT1B 160 TMD 63	XT1B 160 TMD 63	OT63F	S203 - B6	Total
400	60	10	XT2N 160 TMA 125	XT2N 160 TMA 125	OT125F	S203 - B40	Total
400	80	10	XT2N 160 TMA 160	XT2N 160 TMA 160	OT160EV	S203 - B50	Total
400	100	10	XT5N 400 Ekip Dip LSI 400	XT5N 400 Ekip Dip LSI 400	XT5D 400	XT2N 160 Ekip Dip LSI 100	Total
400	120	10	XT5N 400 Ekip Dip LSI 400	XT5N 400 Ekip Dip LSI 400	XT5D 400	XT2N 160 Ekip Dip LSI 100	Total
400	160	100	XT5L 400 Ekip Dip LSI 400	XT5L 400 Ekip Dip LSI 400	XT5D 400	XT2L 160 Ekip Dip LSI 100	Total
400	200	70	XT5H 630 Ekip Dip LSI 630	XT5H 630 Ekip Dip LSI 630	XT5D 630	XT2H 160 Ekip Dip LSI 160	Total
400	250	100	XT5L 630 Ekip Dip LSI 630	XT5L 630 Ekip Dip LSI 630	XT5D 630	XT2L 160 Ekip Dip LSI 160	Total
400	300	100	XT7L 800 Ekip Dip LSI 800	XT7L 800 Ekip Dip LSI 800	XT7D 800	XT4L 250 Ekip Dip LSI 250	Total
400	400	100	XT7L 800 Ekip Dip LSI 800	XT7L 800 Ekip Dip LSI 800	XT7D 800	XT4L 250 Ekip Dip LSI 250	Total
400	500	100	XT7L 1000 Ekip Dip LSI 1000	XT7L 1000 Ekip Dip LSI 1000	XT7D 1000	XT4L 250 Ekip Dip LSI 250	Total

(1) The rated ultimate short circuit breaking capacity (Icu) of the circuit-breakers listed here must be chosen in accordance with the prospective short circuit current at the installation point
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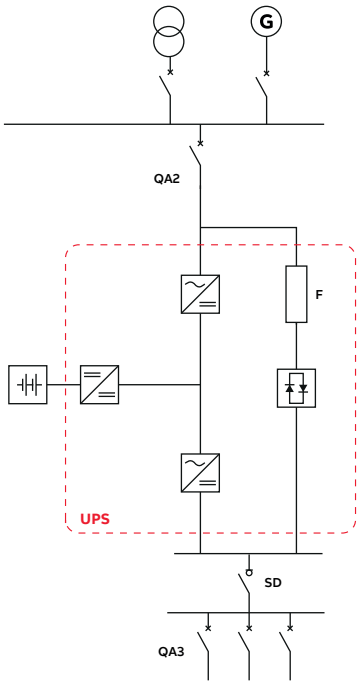
(3) Optional device, suggested instead of a circuit-breaker for selectivity purposes
(4) The reported circuit breaker is granting the selectivity level displayed in the column “Bypass Branch Selectivity F-QA3”. The rated ultimate short circuit breaking capacity (Icu) of the circuit-breaker indicated here must be chosen in accordance with the prospective short circuit current at the installation point

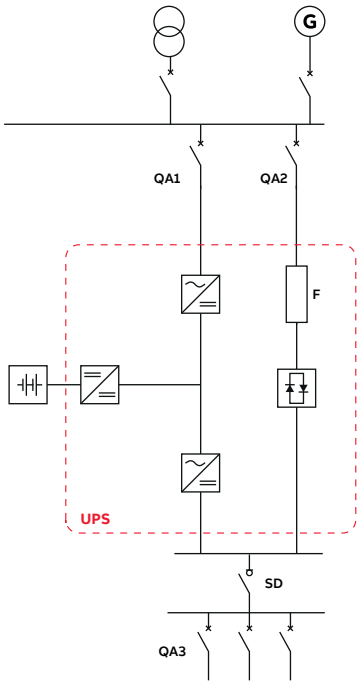
TLE Series

Available Configurations

Single Input Feed



Dual Input Feed



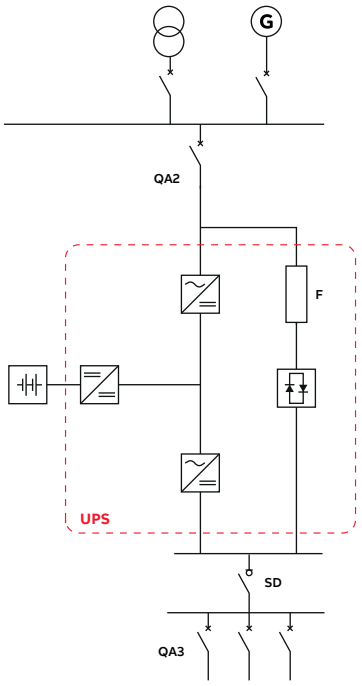
Nominal Voltage [V]	UPS Nominal power [kW]	UPS Icw [kA]	Rectifier Circuit-Breaker QA1 (1)	Bypass Circuit Breaker QA2 (2)	Switch Disconnector SD (3)	Load Circuit Breaker QA3 (4)	Bypass Branch Selectivity F-QA3
400	160	70	XT5H 400 Ekip Dip LSI 400	XT5H 400 Ekip Dip LSI 400	XT5D 400	S203P - B40	Total
400	200	70	XT5H 630 Ekip Dip LSI 630	XT5H 630 Ekip Dip LSI 630	XT5D 630	S203P - B40	Total
400	320	100	XT7L 800 Ekip Dip LSI 630	XT7L 800 Ekip Dip LSI 630	XT7D 1000	S203P - B63	Total
400	400	100	XT7L 800 Ekip Dip LSI 800	XT7L 800 Ekip Dip LSI 800	XT7D 1000	S203P - B63	Total
400	600	100	XT7L 1250 Ekip Dip LSI 1250	XT7L 1250 Ekip Dip LSI 1250	XT7D 1250	XT4L 250 Ekip Dip LSI 250	Total
400	800	100	XT7L 1600 Ekip Dip LSI 1600	XT7L 1600 Ekip Dip LSI 1600	XT7D 1600	XT4L 250 Ekip Dip LSI 250	Total

(1) The rated ultimate short circuit breaking capacity (Icu) of the circuit-breakers listed here must be chosen in accordance with the prospective short circuit current at the installation point
(2) The rated ultimate short circuit breaking capacity (Icu) of the circuit-breakers listed here must to be chosen in accordance with the prospective short circuit current at the installation point. If the configuration is the single input feed type, this is the circuit-breaker to be used for correct electrical dimensioning
(3) Optional device, suggested instead of a circuit-breaker for selectivity purposes
(4) The reported circuit breaker is granting the selectivity level displayed in the column “Bypass Branch Selectivity F-QA3”. The rated ultimate short circuit breaking capacity (Icu) of the circuit-breaker indicated here must be chosen in accordance with the prospective short circuit current at the installation point

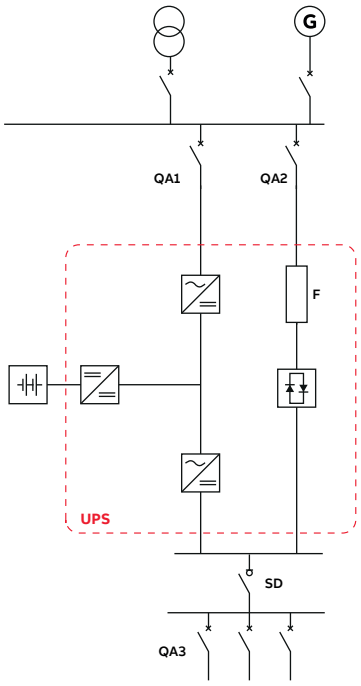
PowerScale

Available Configurations

Single Input Feed



Dual Input Feed



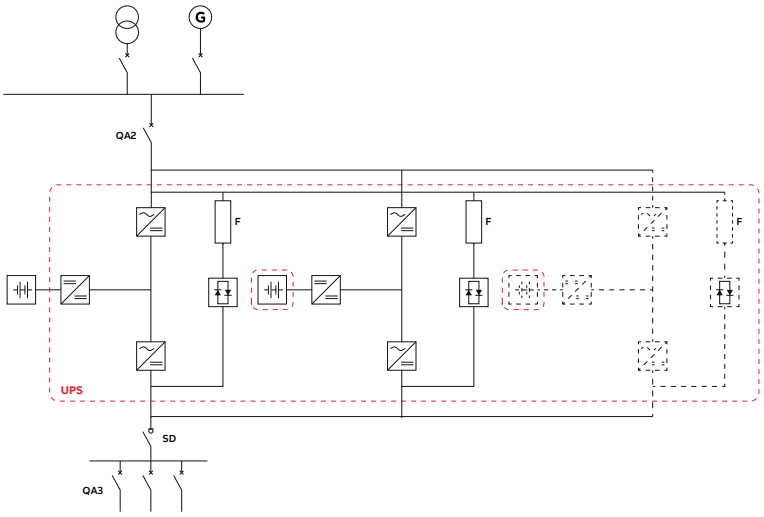
Nominal Voltage [V]	UPS Nominal power [kW]	UPS Icw [kA]	Rectifier Circuit-Breaker QA1 (1)	Bypass Circuit Breaker QA2 (2)	Switch Disconnector SD (3)	Load Circuit Breaker QA3 (4)	Bypass Branch Selectivity F-QA3
400	10	10	S203 - C32	S203 - C32	OT40F	- (5)	- (5)
400	15	10	XT1N 160 TMD 25	XT1N 160 TMD 25	OT63F	- (5)	- (5)
400	20	10	XT1N 160 TMD 25	XT1N 160 TMD 25	OT63F	- (5)	- (5)
400	25	10	XT1N 160 TMD 100	XT1N 160 TMD 100	OT80F	S203 - B16	Up to 0.7kA
400	30	10	XT1N 160 TMD 100	XT1N 160 TMD 100	OT100F	S203 - B16	Up to 0.9kA
400	40	10	XT1N 160 TMD 100	XT1N 160 TMD 100	OT125F	S203 - B25	Up to 1.3kA
400	50	10	XT1N 160 TMD 125	XT1N 160 TMD 125	OT125F	S203 - B25	Up to 1.5kA

(1) The rated ultimate short circuit breaking capacity (Icu) of the circuit-breakers listed here must be chosen in accordance with the prospective short circuit current at the installation point
(2) The rated ultimate short circuit breaking capacity (Icu) of the circuit-breakers listed here must be chosen in accordance with the prospective short circuit current at the installation point. If the configuration is the single input feed type, this is the circuit-breaker to be used for correct electrical dimensioning
(3) Optional device, suggested instead of a circuit-breaker for selectivity purposes
(4) The reported circuit breaker is granting the selectivity level displayed in the column “Bypass Branch Selectivity F-QA3”. The rated ultimate short circuit breaking capacity (Icu) of the circuit-breaker indicated here must be chosen in accordance with the prospective short circuit current at the installation point
(5) No level of selectivity achieved

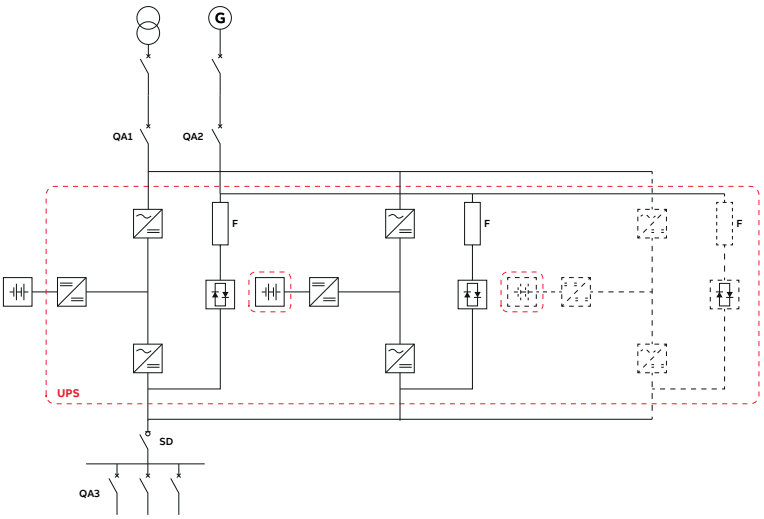
Conceptower DPA 250 S4

Available Configurations

Single Input Feed



Dual Input Feed



Nominal Voltage [V]	Nr. Modules	UPS Nominal power [kW]	UPS Icw [kA]	Rectifier Circuit-Breaker QA1 (1)	Bypass Circuit Breaker QA2 (2)	Switch Disconnector SD (3)	Load Circuit Breaker QA3 (4)	Bypass Branch Selectivity F-QA3	Bypass Branch Selectivity QA2-F
400	1	50	10	XT1B 160 TMD 160	XT3N 250 TMD 200	XT3D 250	S203 - B25	Up to 0.6kA	Total
400	2	100	10	XT3N 250 TMD 200	XT3N 250 TMD 200	XT3D 250	S203 - B25	Up to 1.75kA	Total
400	3	150	10	XT5N 400 TMA 320	XT5N 400 TMA 320	XT5D 400	S203 - B63	Up to 2.5kA	Total
400	4	200	10	XT5N 400 TMA 400	XT5N 400 TMA 400	XT5D 400	S203 - B63	Up to 4.2kA	Total
400	5	250	10	XT5N 630 TMA 630	XT5N 630 TMA 630	XT5D 630	S203 - B63	Up to 6.8kA	Total
400	6	300	10	XT5N 630 TMA 630	XT5N 630 TMA 630	XT5D 630	S203 - B63	Total	Total

(1) The rated ultimate short circuit breaking capacity (Icu) of the circuit-breakers listed here must be chosen in accordance with the prospective short circuit current at the installation point

(2) The rated ultimate short circuit breaking capacity (Icu) of the circuit-breakers listed here must be chosen in accordance with the prospective short circuit current at the installation point. If the configuration is the single input feed type, this is the circuit-breaker to be used for correct electrical dimensioning. In addition, the indicated circuit-breaker provides the selectivity level given in the “Bypass Branch Selectivity QA2-F” column.

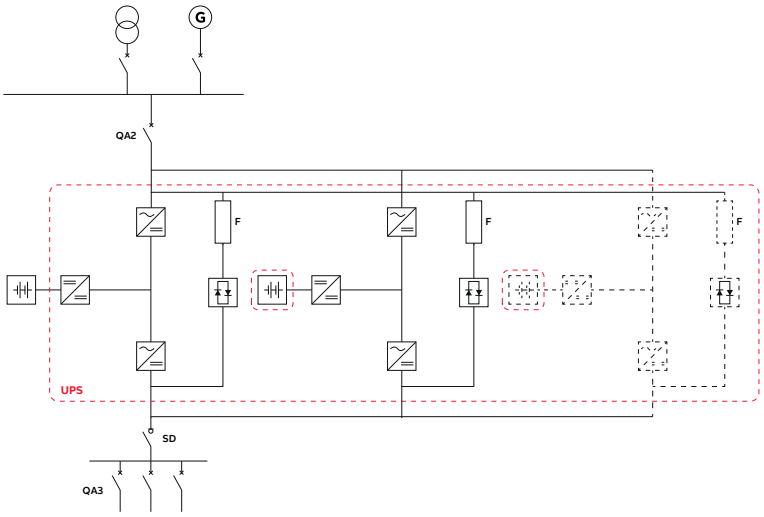
(3) Optional device, suggested instead of a circuit-breaker for selectivity purposes

(4) The reported circuit breaker is granting the selectivity level displayed in the column “Bypass Branch Selectivity F-QA3”. The rated ultimate short circuit breaking capacity (Icu) of the circuit-breaker indicated here must be chosen in accordance with the prospective short circuit current at the installation point

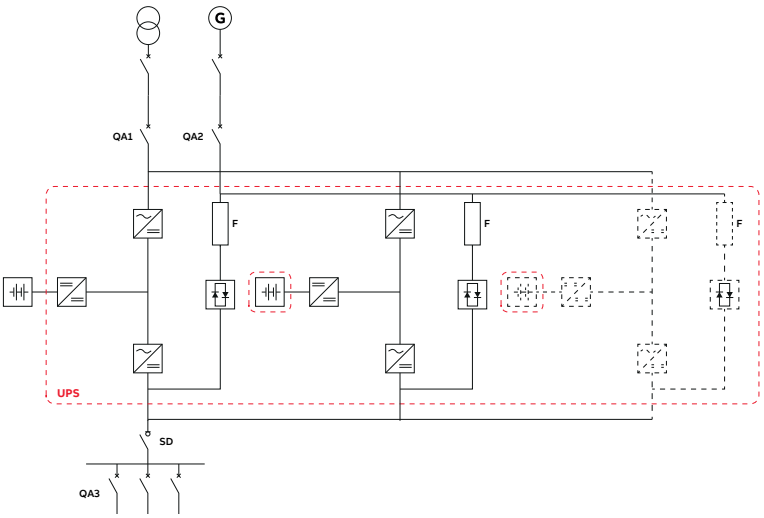
Conceptower DPA 500

Available Configurations

Single Input Feed



Dual Input Feed



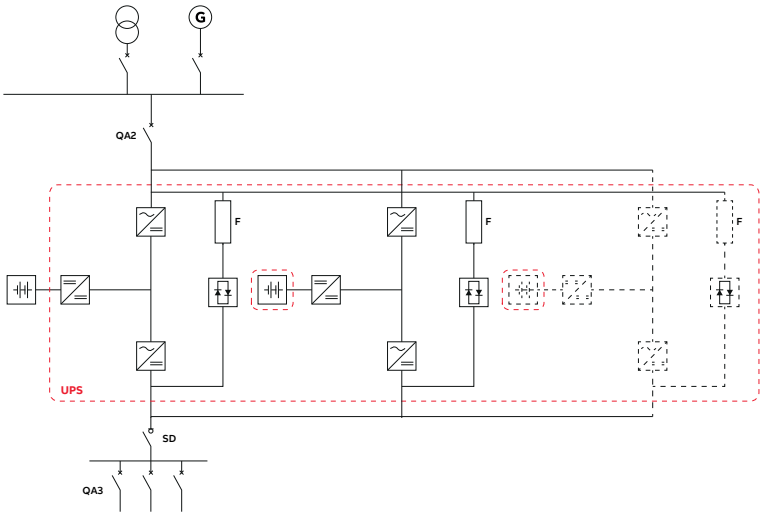
Nominal Voltage [V]	Nr. Modules	UPS Nominal power [kW]	UPS Icw [kA]	Rectifier Circuit-Breaker QA1 (1)	Bypass Circuit Breaker QA2 (2)	Switch Disconnector SD (3)	Load Circuit Breaker QA3 (4)	Bypass Branch Selectivity F-QA3	Bypass Branch Selectivity QA2-F
400	1	100	25	XT3N 250 TMD 200	XT3N 250 TMD 200	XT5D 400	S203 - B63	Up to 8.4kA	Total
400	2	200	25	XT5N 400 TMA 400	XT5N 400 TMA 400	XT5D 630	S803 - B125	Total	Total
400	3	300	25	XT5N 630 TMA 630	XT5N 630 TMA 630	XT6D 630	XT2N 160 TMA 160	Total	Total
400	4	400	25	XT6N 800 TMA 800	XT6N 800 TMA 800	XT6D 630	XT4N 250 TMA 250	Total	Total
400	5	500	25	XT6N 1000 Ekip Dip LSI 1000	XT6N 1000 Ekip Dip LSI 1000	XT6D 1000	XT4N 250 TMA 250	Total	Total

(1) The rated ultimate short circuit breaking capacity (Icu) of the circuit-breakers listed here must be chosen in accordance with the prospective short circuit current at the installation point
(2) The rated ultimate short circuit breaking capacity (Icu) of the circuit-breakers listed here must be chosen in accordance with the prospective short circuit current at the installation point. If the configuration is the single input feed type, this is the circuit-breaker to be used for correct electrical dimensioning. In addition, the indicated circuit-breaker provides the selectivity level given in the “Bypass Branch Selectivity QA2-F” column.
(3) Optional device, suggested instead of a circuit-breaker for selectivity purposes
(4) The reported circuit breaker is granting the selectivity level displayed in the column “Bypass Branch Selectivity F-QA3”. The rated ultimate short circuit breaking capacity (Icu) of the circuit-breaker indicated here must be chosen in accordance with the prospective short circuit current at the installation point

Megaflex DPA

Available Configurations

Single Input Feed



Nominal Voltage [V]	UPS Nominal power [kW]	UPS Icw [kA]	Rectifier Circuit-Breaker QA1 (1)	Bypass Circuit Breaker QA2 (2)	Switch Disconnector SD (3)	Load Circuit Breaker QA3	Bypass Branch Selectivity F-QA3
400	1000	120	E2.2H 2000 Ekip Dip LSI 2000	E2.2N/MS	XT5L 630 TMA 630	Total	Total
400	1250	120	E4.2V 3200 Ekip Dip LSI 2500	E4.2N/MS	XT5L 630 TMA 630	Total	Total
400	1500	120	E4.2V 3200 Ekip Dip LSI 3200	E4.2N/MS	XT7L 1600 Ekip Dip LSI 1600	Up to 29kA	Total

(1) The rated ultimate short circuit breaking capacity (Icu) of the circuit-breakers listed here must be chosen in accordance with the prospective short circuit current at the installation point. In addition, the indicated circuit-breaker provides the selectivity level given in the "Bypass Branch Selectivity QA2-F" column
(2) Optional device, suggested instead of a circuit-breaker for selectivity purposes
(3) The reported circuit breaker is granting the selectivity level displayed in the column "Bypass Branch Selectivity F-QA3". The rated ultimate short circuit breaking capacity (Icu) of the circuit-breaker indicated here must be chosen in accordance with the prospective short circuit current at the installation point

EcoSolutions Label

The MegaFlex DPA™ Uninterruptible Power Supply (UPS) has become the first Smart Power product to earn ABB's new EcoSolutions label, reflecting the focus on circularity and sustainability that guides our product development process.
To earn an EcoSolution label, a product must first obtain an independently verified Type III ISO:14025 Environmental Product Declaration. It must then meet a minimum of four ABB sustainability targets, one from each of the key stages in its lifecycle.
The MegaFlex DPA UPS was designed to close resource loops with a strong 75% recyclability rate and clear end-of-life instructions for the user. The Quartino production facility in Switzerland produces MegaFlex DPA with 'zero waste to landfill' and packaging that uses 80% recycled cardboard.
Use of MegaFlex DPA has been highly optimized, providing customers with 97.4% system level efficiency and 15-year extended lifetime, thanks to a modular design and services that prolong its working life. According to calculations, MegaFlex customers can save more than 400 tonnes of CO2 equivalent emissions over the lifetime of the UPS. Our MegaFlex DPA UPS solution combines the highest efficiency ratings available with our commitment to the circular economy.
This not only helps reduce energy losses and operating costs, but also provides a product that uses minimal resources and materials that can be easily recycled.
Learn more at MegaFlex DPA - UPS and power conditioning | ABB

ABB EcoSolutions™
Coming full circle.

Together with customers and partners, ABB is innovating to make circular, increasingly sustainable solutions and operations a reality.
ABB's new EcoSolutions label provides full transparency to environmental impacts across the entire product lifecycle.
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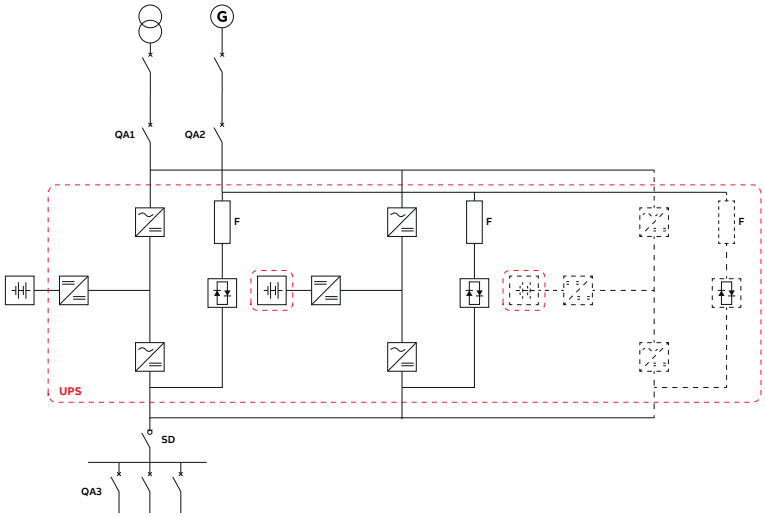
ABB Eco Solutions™

Powerline DPA

Available Configurations

Dual Input Feed



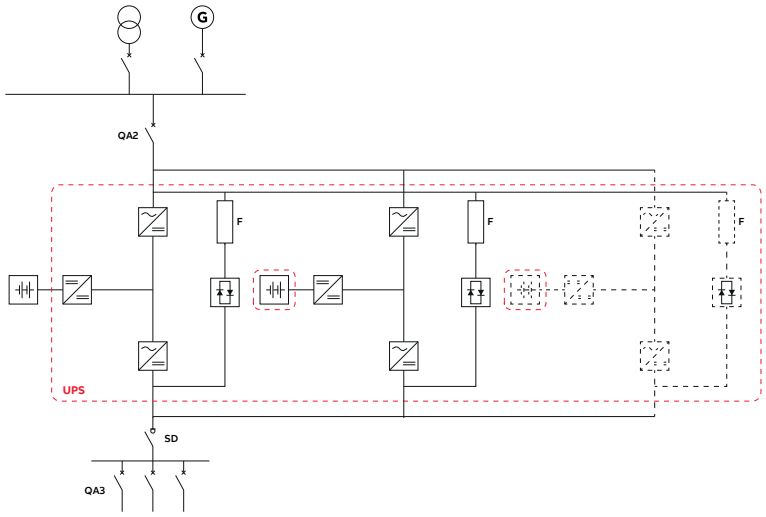
Nominal Voltage [V]	UPS Configuration	Nr. Modules	Nominal power UPS [kW]	UPS Icw [kA]	Rectifier Circuit-Breaker QA1 (1)	Bypass Circuit-Breaker QA2 (2)	Load Circuit-Breaker QA3 (4)	Bypass Branch Selectivity F-QA3
400	PowerLine DPA 33	1	20	10	XT5 630 Ekip 400	XT5 630 Ekip 400	S203 B 10A	up to 0,7 kA
400	PowerLine DPA 33	1	40	10	XT5 630 Ekip 400	XT5 630 Ekip 400	S203 B 25A	up to 1,5kA
400	PowerLine DPA 33	2	80	10	XT5 630 Ekip 630	XT5 630 Ekip 630	S203 B 63A	up to 4kA
400	PowerLine DPA 33	3	120	10	XT5 630 Ekip 400	XT5 630 Ekip 400	S803 B 80A	up to 5kA
400	PowerLine DPA 33 Redundant	2	20	10	XT5 630 Ekip 400	XT5 630 Ekip 400	S203 B 10A	up to 0,7 kA
400	PowerLine DPA 33 Redundant	2	40	10	XT5 630 Ekip 400	XT5 630 Ekip 400	S203 B 25A	up to 1,5kA
400	PowerLine DPA 33 Redundant	4	80	10	XT5 630 Ekip 630	XT5 630 Ekip 630	S203 B 63A	up to 4kA
400	PowerLine DPA 33 Redundant	6	120	10	XT5 630 Ekip 400	XT5 630 Ekip 400	S803 B 80A	up to 5kA
400	PowerLine DPA 31	1	20	10	XT5 630 Ekip 400	XT5 630 Ekip 400	S203 B 10A	up to 0,7 kA
400	PowerLine DPA 31	1	20	10	XT5 630 Ekip 400	XT5 630 Ekip 400	S203 B 10A	up to 0,7 kA
400	PowerLine DPA 31	2	40	10	XT5 630 Ekip 630	XT5 630 Ekip 630	S203 B 63A	up to 4kA
400	PowerLine DPA 31 N+1	2	40	10	XT5 630 Ekip 630	XT5 630 Ekip 630	S203 B 63A	up to 4kA
400	PowerLine DPA 31 N+1	2	80	10	XT5 630 Ekip 630	XT5 630 Ekip 630	S203 B 63A	up to 4kA
400	PowerLine DPA 31 N+1	3	80	10	XT5 630 Ekip 400	XT5 630 Ekip 400	S803 B 80A	up to 5kA

(1) The rated ultimate short circuit breaking capacity (Icu) of the circuit-breakers listed here must be chosen in accordance with the prospective short circuit current at the installation point.
(2) The rated ultimate short circuit breaking capacity (Icu) of the circuit-breakers listed here must be chosen in accordance with the prospective short circuit current at the installation point. If the configuration is the single input feed type, this is the circuit-breaker to be used for correct protection and selectivity.
In addition, the indicated circuit-breaker provides the selectivity level given in the “Bypass Branch Selectivity QA2-F” column.
(3) Optional device, suggested instead of a circuit-breaker for selectivity purposes
(4) The reported circuit breaker is granting the selectivity level displayed in the column “Bypass Branch Selectivity F-QA3”. The rated ultimate short circuit breaking capacity (Icu) of the circuit-breaker indicated here must be chosen in accordance with the prospective short circuit current at the installation point

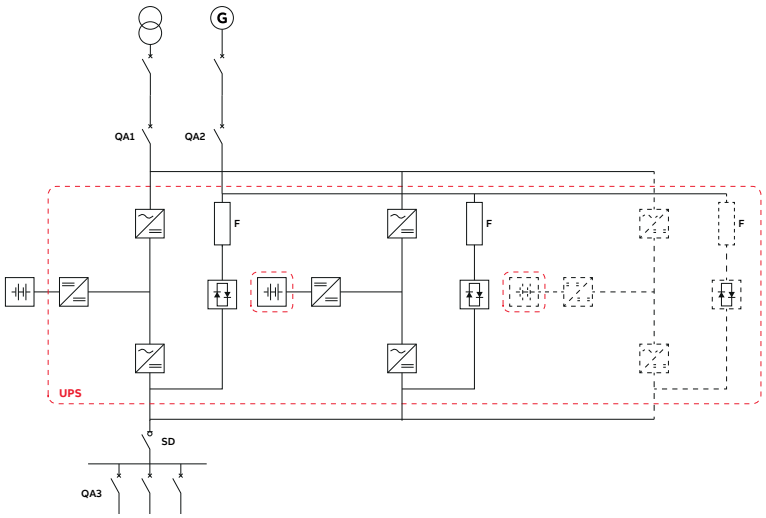
DPA UPScale ST/RI

Available Configurations

Single Input Feed



Dual Input Feed



UPS Series	Number of Modules	Module rated power [kW]	UPS Nominal power [kW]	UPS Icw [kA]	Rectifier Circuit Breaker QA1 (1)	Bypass Circuit Breaker QA2 (2)	Switch Disconnector SD (3)	Load Circuit Breaker QA3 (4)	Bypass Branch Selectivity F-QA3	Bypass Branch Selectivity QA2-F
UPScale ST 40	2	10	20	10	XT1B 160 TMD 32	XT1B 160 TMD 32	OT40F	- (5)	- (5)	- (5)
UPScale ST 40	2	20	40	10	XT1B 160 TMD 100	XT1B 160 TMD 100	OT100F	S200 - B16	Total	Up to 0.8kA
UPScale ST 60	3	10	30	10	XT1B 160 TMD 100	XT1B 160 TMD 100	OT100F	S200 - B25	Total	Up to 0.4kA
UPScale ST 60	3	20	60	10	XT1B 160 TMD 125	XT1B 160 TMD 125	OT125F	S200 - B25	Total	Up to 1.3kA
UPScale ST 80	4	10	40	10	XT1B 160 TMD 125	XT1B 160 TMD 125	OT125F	S200 - B32	Total	Up to 0.5kA
UPScale ST 80	4	20	80	10	XT1B 160 TMD 160	XT1B 160 TMD 160	OT160F	S200 - B50	Total	Up to 1,8kA
UPScale ST 120	6	10	60	10	XT1B 160 TMD 125	XT1B 160 TMD 125	OT125F	S200 - B50	Total	Up to 0.9kA
UPScale ST 120	6	20	120	10	XT1B 160 TMD 250	XT1B 160 TMD 250	XT3D 250	S200 - B63	Total	Up to 3.5kA
UPScale ST 200	10	10	100	10	XT1B 160 TMD 200	XT1B 160 TMD 200	XT3D 250	S800 - B80	Total	Total
UPScale ST 200	10	20	200	10	XT5N 400 Ekip Dip 400	XT5N 400 Ekip Dip 400	XT5D 400	XT1B 160 TMD 160	Total	Up to 7kA
UPScale RI 10	1	10	10	10	S200 - C20	S200 - C20	OT16F	- (5)	- (5)	- (5)
UPScale RI 10	1	20	20	10	XT1B 160 TMD 100	XT1B 160 TMD 100	OT100F	S200 - B10	Total	Up to 0.4kA
UPScale RI 11	1	10	10	10	S200 C 20	S200 C 20	OT16F	- (5)	- (5)	- (5)
UPScale RI 11	1	20	20	10	XT1B 160 TMD 100	XT1B 160 TMD 100	OT100F	S200 - B10	Total	Up to 0.4kA
UPScale RI 12	1	10	10	10	S200 C 20	S200 C 20	OT16F	- (5)	- (5)	- (5)
UPScale RI 12	1	20	20	10	XT1B 160 TMD 100	XT1B 160 TMD 100	OT100F	S200 - B10	Total	Up to 0.4kA
UPScale RI 20	2	10	20	10	S200 - C63	S200 - C63	OT63F	- (5)	- (5)	- (5)
UPScale RI 20	2	20	40	10	XT1B 160 TMD 100	XT1B 160 TMD 100	OT100F	S200 - B25	Total	Up to 0.8kA
UPScale RI 22	2	10	20	10	S200 - C63	S200 - C63	OT63F	- (5)	- (5)	- (5)
UPScale RI 22	2	20	40	10	XT1B 160 TMD 100	XT1B 160 TMD 100	OT100F	S200 - B25	Total	Up to 0.8kA
UPScale RI 24	2	10	20	10	S200 - C63	S200 - C63	OT63F	- (5)	- (5)	- (5)
UPScale RI 24	2	20	40	10	XT1B 160 TMD 100	XT1B 160 TMD 100	OT100F	S200 - B25	Total	Up to 0.8kA
UPScale RI 40	4	10	40	10	XT1B 160 TMD 125	XT1B 160 TMD 125	OT125F	S200 - B32	Total	Up to 0.6kA
UPScale RI 40	4	20	80	10	XT1B 160 TMD 160	XT1B 160 TMD 160	OT160F	S200 - B50	Total	Up to 1.8kA

(1) The rated ultimate short circuit breaking capacity (Icu) of the circuit-breakers listed here must be chosen in accordance with the prospective short circuit current at the installation point.
(2) The rated ultimate short circuit breaking capacity (Icu) of the circuit-breakers listed here must be chosen in accordance with the prospective short circuit current at the installation point. If the configuration is the single input feed type, this is the circuit-breaker to be used for correct electrical dimensioning.
(3) Optional device, suggested instead of a circuit-breaker for selectivity purposes.
(4) The indicated circuit-breaker provides the selectivity level given in the "Bypass Branch Selectivity F-QA3" column. The rated ultimate short circuit breaking capacity (Icu) of the indicated circuit-breaker must be chosen in accordance with the prospective short circuit current at the installation point.
(5) No level of selectivity achieved.

Note:

(1) Disclaimer

The information in the coordination table document reflects the state of our knowledge at the time of publication. Its purpose is to present our power continuity products, their coordination and possible applications, as defined by the applicable International standards. All the devices mentioned in the coordination tables must be installed and used as indicated by the product data and instructions provided in the installation manuals and user manuals of the products themselves.
These coordination tables are provided "as is" and with no express warranty. ABB also disclaims all other statutory and implied warranties, including, but not limited to, any warranty of fitness for a particular purpose or merchantability. The user and user's company agree that in no event will ABB be liable to the user or user's company for any claims, liabilities or damages even if caused by the negligence of ABB, and under no circumstances will ABB be liable for any indirect, special, incidental or consequential damages.

(2) Liability

The devices mentioned in the coordination tables do not endanger safety when they are selected, mounted, commissioned, used, serviced and disassembled in compliance with the applicable rules and standards and in accordance with the relative user manual. The devices must be used by experts and suitably trained people.
The selections in the coordination table must be verified and approved by the user.

(3) Additional information

We reserve the right to make technical changes and modify the contents of this document without prior notice. With regard to purchase orders, the agreed particulars shall prevail. ABB declines all and every liability for potential errors or possible lack of information in this document.

Bill of Materials

For the sake of clarity, an example of a bill of materials created according to the guidelines provided in the Site Planning tool is given below.

In this example, the bill of materials required for coordination purposes refers to a DPA 250 S4 modular UPS of the largest available size (250 kW).

Quantity	Ordering code	Product name
1	4NWP104094R0001	DPA250S4 F250 FRAME MBS
5	4NWP103846R0001	UPS MODULE DPA250S4 50KW
2	1SDA100347R1	XT5N 630 TMA 630-6300 3p F F
1	1SDA100547R1	XT5D 630 3p F F
1	2CDS253001R0635	S203-B63

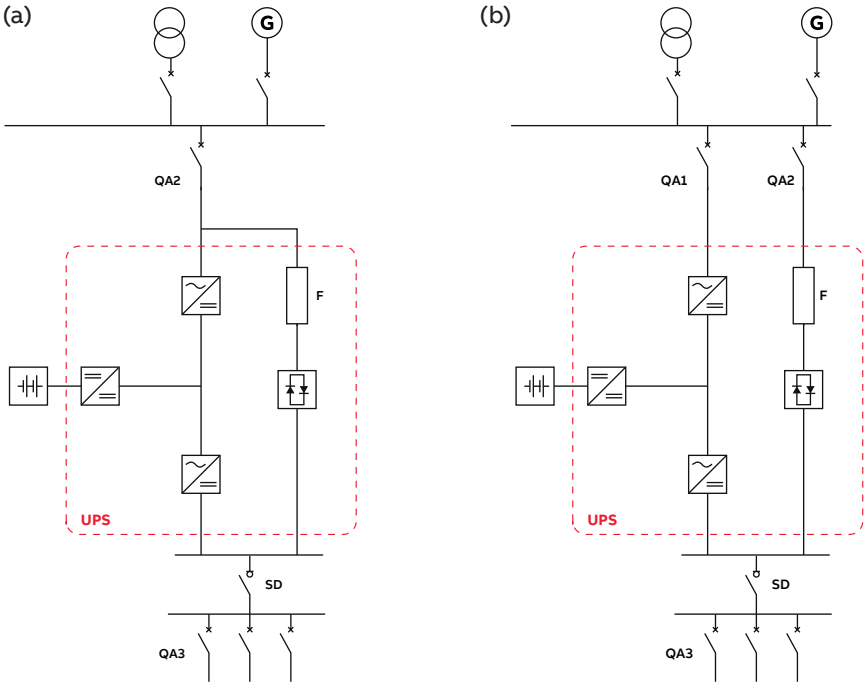
APPLICATION FINDER

We've made it simpler for you to set up your project!
Click here to find the reference architecture that best fits your needs and download the Bill of Materials.

The engineering study behind the Site Planning Tool

Selectivity with Standalone UPSes

Selectivity between the downstream circuit-breaker and the fuse in the static bypass is the one to be considered.



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Simplified diagram of a Double Conversion UPS with one (a) or two (b) input feeds

To achieve this configuration, we applied the following rules:

1. Let-through energy i2t of downstream breaker lower than pre-arcing I2t of upstream fuse.
2. Short circuit selectivity ensured when short circuit current is higher than the instantaneous threshold of the circuit-breaker.
3. Tripping time of circuit-breakers for instantaneous trip threshold less than pre-arcing time of fuse.

In view of all the above considerations, the equations for verifying selectivity between the downstream circuit-breaker and upstream fuse are the following:

Rule 1

a) $I_{CB}{}^2t < \textit{pre-arcing}\ I_F{}^2t * k_1$

Where:

$I_{CB}{}^2t$ = let-through energy of downstream circuit-breakers, as declared by the manufacturer

$\textit{pre-arcing}\ I_F{}^2t$ = pre-arcing let-through energy of upstream fuses, as declared by the manufacturer

k_1 = safety factor

Rule 3

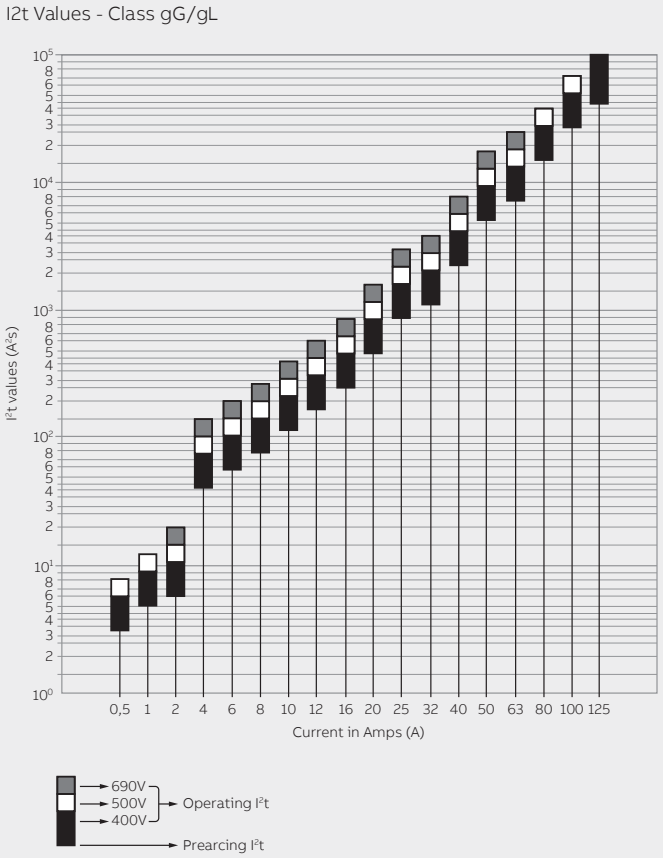
b) $t_{CB} < t_{F\ \textit{pre-arc}}$

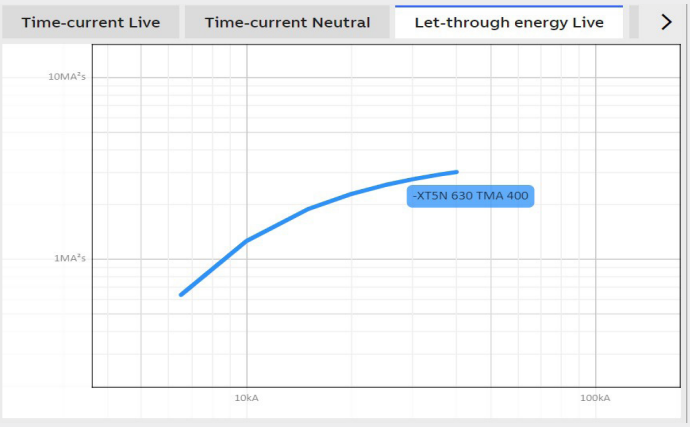
Where:

t_{CB} = tripping time of a circuit-breaker for fault current equal to the instantaneous trip threshold of the circuit-breaker

$t_{F\ \textit{pre-arc}}$ = fuse pre-arcing time, as declared by the manufacturer

—
Fuse let-through energy diagram





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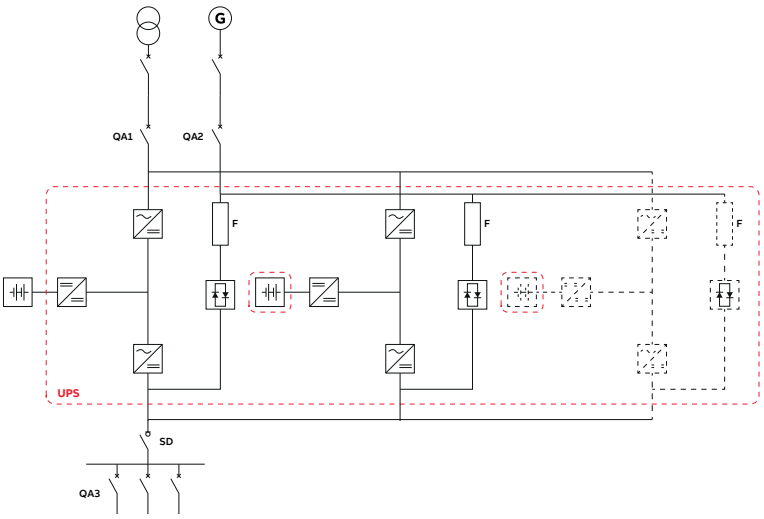
Circuit-Breaker let-through energy diagram

Selectivity with Modular UPSs

ABB Modular UPS design is based on DPA (Decentralized Parallel Architecture) architecture. In DPA architecture, each UPS module contains all the hardware and software required for full UPS system operation.

The modules do not share any of the components and each module is a fully functional UPS. Thus the DPA system is able to increase system reliability and maximize uptime. The UPS modules are in parallel to provide redundancy or to increase the total capacity of the system.

—
DPA architecture (the modules are totally independent of each other)



Getting back to the subject of selectivity, because the fuse in every UPS module is considered to be in parallel with the other, two different co-ordinations need to be verified:

- Selectivity between upstream fuses in parallel and downstream circuit-breakers
- Selectivity between fuses in parallel and upstream circuit-breakers, if it is the only input or is located at the bypass feeder

The following rules have been considered for the purpose of verifying selectivity between upstream fuses in parallel and downstream breakers:

1. Let-through energy I2t of downstream circuit-breaker lower than pre-arcing I2t of upstream fuse, multiplied by the square value of the number of fuses in parallel.
2. Short circuit selectivity ensured when short circuit current is higher than the instantaneous threshold protection of the circuit-breaker.
3. Tripping time of circuit-breakers for instantaneous trip threshold less than pre-arcing time of fuse.

In view of all the above considerations, the equations to verify selectivity between up-stream fuses in parallel and downstream breakers are the following:

Rule 1

c) $I_{CB}{}^2t < \text{pre-arcing } I_F{}^2t * k_2 * N^2$

Where:

$I_{CB}{}^2t$ = let-through energy of downstream circuit-breakers, as declared by the manufacturer

$\text{pre-arcing } I_F{}^2t$ = pre-arcing let-through energy of upstream fuses, as declared by the manufacturer

N = number of fuses in parallel

k_2 = safety factor

Rule 3

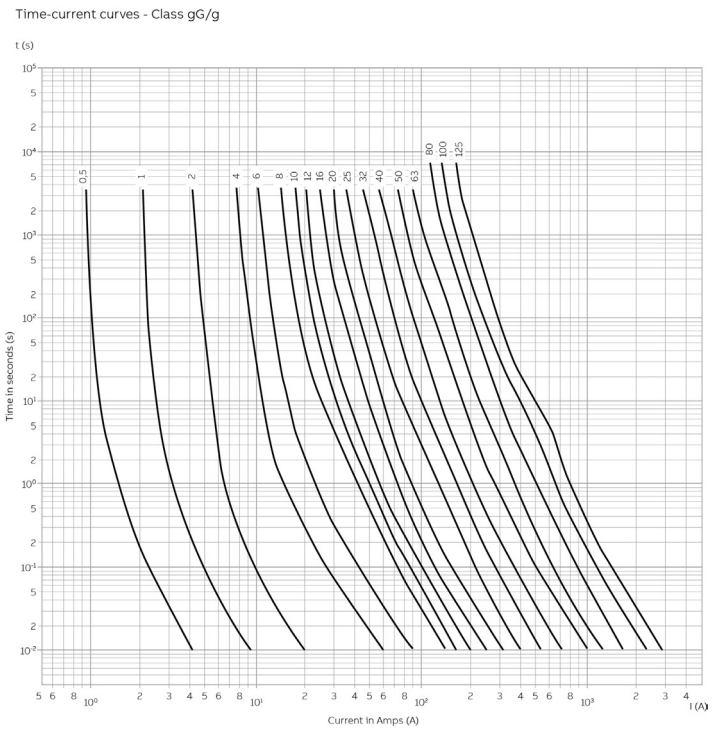
d) $t_{CB} < t_{F\ pre\text{-}arc}$

Where:

t_{CB} = tripping time of a circuit-breaker for fault current equal to the instantaneous trip threshold of the circuit-breaker

$t_{F\ pre\text{-}arc}$ = pre-arcing time of the fuse, as declared by the manufacturer

—
Fuse pre-arcing time



Selectivity between downstream fuses in parallel and the upstream circuit-breaker

The following rule was considered when verifying the selectivity between the upstream circuit-breaker and downstream fuses in parallel:

- let-through energy I2t of upstream circuit-breaker higher than melting I2t of downstream fuse, multiplied by the square value of the number of fuses in parallel.

In view of the above considerations, the equation for verifying selectivity between the up-stream circuit-breaker and downstream fuses in parallel is the following:

e) $I_{CB}{}^2t < melting\ I_F{}^2t * N^2$

Where:

$I_{CB}{}^2t$ = let-through energy of downstream circuit-breakers, as declared by the manufacturer

$melting\ I_F{}^2t$ = melting let-through energy of downstream fuses, as declared by the manufacturer

N = number of fuses in parallel

Circuit-Breaker protection settings

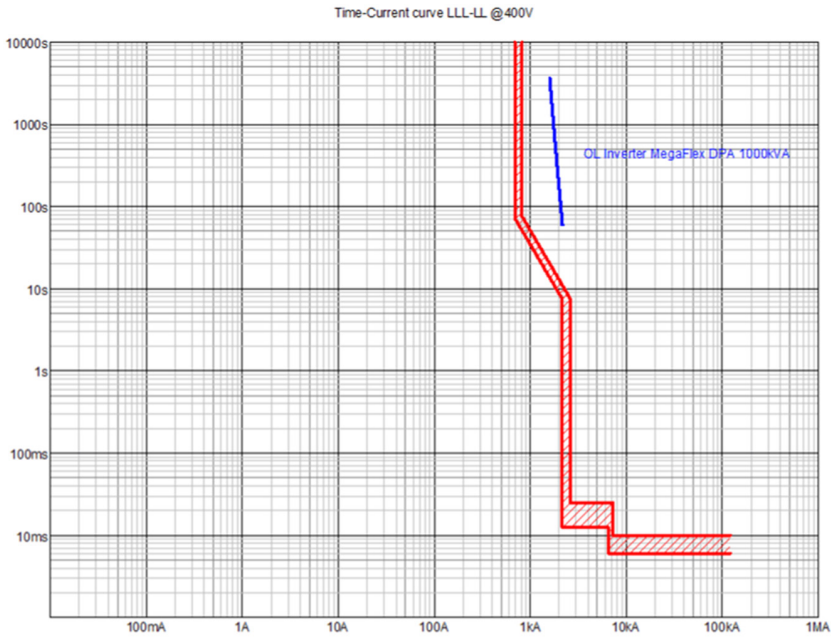
Having determined the size and frame of circuit-breakers QA1, QA2 and QA3, the last step for ensuring selectivity is to choose the protection settings wisely.
This step can be divided into two parts: Overload Zone and Short Circuit Zone.

Overload Zone

Overload zone means the ranges of current values which are not 8-10 times higher than the rated current of QA3.
As explained earlier, if a short circuit occurs the UPS automatically switches from the double conversion mode to static bypass, but this is not the case for overload, at least not for a certain period of time.
The actors in this type of selectivity are:

- Circuit-breaker QA3, which has to act first to protect the UPS;
- The inverter with its withstand capability;
- Circuit-breaker QA1, which should never open in this selectivity chain.

To obtain the correct sequence, the settings should enable circuit-breaker QA3 to act more rapidly than the inverter.
The expected coordination is illustrated in Figure below:



Short Circuit Zone

Short Circuit Zone means the ranges of current values which are the same or 10 times higher than the rated current of the circuit-breaker.
Here again, the actors in this type of selectivity are the same, but with additional settings:

- The magnetic protection of QA3 should be set at a lower value than the short circuit withstand capability of the inverter.
- If QA1/QA2 are equipped with thermomagnetic trip unit, the instantaneous protection should be at its maximum setting. If, instead, they are equipped with an electronic trip unit, the I3 instantaneous protection should be set to OFF.

To complete the information required to correctly size the circuit-breakers that protect the UPS, the last component to consider is the main circuit-breaker on the DC side in the Battery Racks.

ABB provides a complete solution (UPS + Batteries), but if required, other batteries from other manufacturers/suppliers can be used.
However, it is important to follow the guidelines to ensure that these two components are coupled correctly.

The guidelines are based on the following considerations:

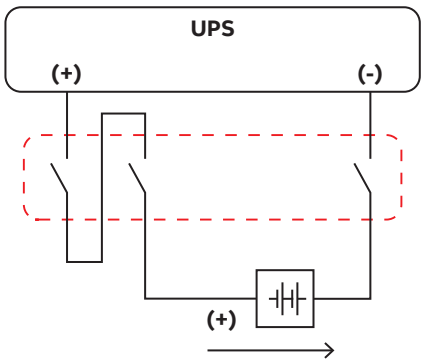
1. DC side of the UPS isolated from the ground
2. Maximum breaking capacity to be selected according to the prospective short circuit current of each individual case
3. Circuit-breaker size to be selected considering the maximum voltage and maximum discharge current
4. To be able to ensure that faults between batteries and circuit-breakers are negligible, the components should be installed very close to each other.
5. Ambient temperature no higher than +40°C.

The ABB Tmax XT range and Emax DC circuit-breakers easily meet the requirements in terms of fast and reactive protection.

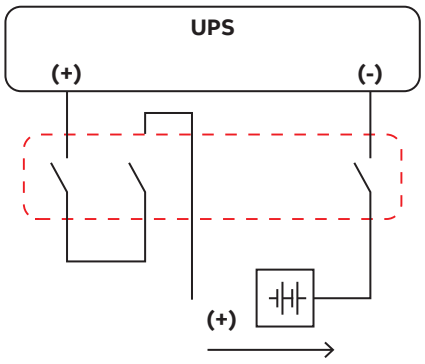
Examples of Tmax XT (on the left) and Emax DC (on the right)

Connection between the batteries and UPS bus is achievable in the 2-pole or 3-pole configurations. In terms of connections and desired achievable operational voltages, the guidelines can be summarized as follows:

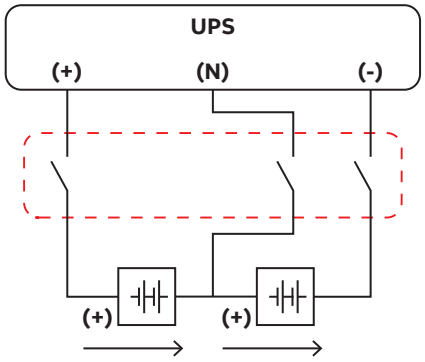
- XT1, XT2 and XT3 3-pole circuit-breakers are recommended for 2-pole UPS Bus configurations if, current permitting, the desired achievable voltage is up to 500 V. Otherwise XT4, XT5, XT6 and XT7 circuit-breakers can easily serve the purpose if the required voltage is up to 750V.



Due to the integrated flapper, the connection is as follows if the Emax DC range is required:



- XT1, XT2 and XT3 3-pole circuit-breakers are recommended for 3-pole UPS Bus configurations if, current permitting, the desired achievable voltage is up to 250 V. Otherwise XT4,XT5, XT6 and XT7 circuit-breakers can easily serve the purpose if the required voltage is up to 500 V.



- XT1, XT2 and XT3 4-pole circuit-breakers are recommended for 3-pole UPS Bus configurations if, current permitting, the desired achievable voltage is up to 500 V. Otherwise XT4, XT5, XT6 and XT7 circuit-breakers can easily serve the purpose if the required voltage is up to 750 V.

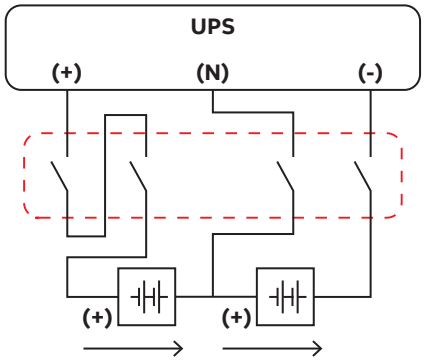


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ABB S.p.A.
Electrification Business Area
Smart Power Division
5, Via Pescaria
I-24123 Bergamo - Italy
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