WHITE PAPER

Automatic Transfer Switching for Redundant Power Systems in Data Centers

UL

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Whether you need to ensure steady power delivery to IT loads or simply keep the lights on, ABB is your "one-stop shop" for transfer switch solutions.

Thanks to our breakthroughs in transfer switch technology and the recent addition of Zenith ZTG and ZTS products, ABB can now offer one of the world's most comprehensive and advanced transfer switch solution portfolios, ranging from well-established technologies to the latest in digital innovation.

You can choose the functionality and features that are just right for your facility, knowing you'll get outstanding reliability even in the most demanding conditions.

Contents

Introduction

Data centers are the driving force that supports today's always-connected society. They ensure that modern services, from health and safety to commerce and entertainment, are always available. Achieving high power system availability is essential for always-on, critical facilities like commercial and on-premises data centers. The challenge is even greater when capital and operational costs, asset management and the maintainability of these vital services are considered.

Automatic Transfer Switches are the workhorses that ensure maximal power system uptime. During a supply interruption in the data center, the ATS selects a backup power source to provide longer-lasting reserve power.
Brief interruptions in the supply IT loads are avoided with a UPS positioned downstream of the ATS.
The ATS is the enabling technology that ensures continuity of power delivery to data center IT loads when switching from primary (utility) to backup power (generators, energy storage). The ATS enables fast recovery from outages and reduces downtime between transfer events. In brief, the incredibly high availability achieved by data center facilities is impossible without ATS solutions.

Automatic Transfer Switching in Data Centers

An Automatic Transfer Switch (ATS) is a device that automatically switches electrical loads from a primary power source to a secondary one (like a generator) if the primary power source fails. As part of a data center's backup power system, the purpose of the ATS is to ensure continuity for all types of electrical loads.

The modern automatic transfer switch combines sensors and switching logic in a hardened package that is both incredibly durable and designed to be 100% available. ATS testing standards (such as UL 1008) ensure that this purpose-built equipment is constructed in a way that ensures greater robustness, versus more general standards for low voltage components and equipment.

Differences between ATS and STS
Both automatic transfer switches (ATS) and static transfer switches (STS) are used in data center power distribution and are UL 1008 listed (STS is UL 1008S). While both types are responsible for switching power sources to an electrical load, the STS can be used in situations requiring nearly continuous power, with little to no tolerance for power interruptions. An STS is a semiconductor-based switching device and is therefore much faster at switching the primary to backup loads (and vice-versa), with switching times that are under 1 cycle (<16ms). STS cost more than ATS and their installation and maintenance costs may also be higher. An advantage, however, is that an STS may be used where the IT loads have less ride-through capability, or in certain redundant system configurations where fall-back power resources are shared and the STS must act immediately to "catch" the IT load without interruption. An STS may also be used to provide supplemental redundancy in more exotic circuit configurations.

Compliance Regime: Codes & Standards
For the UL market, the prevailing standard for transfer switches is UL 1008. While an ATS can be fashioned out of contactors, circuit breakers or even motorized disconnects, it is the UL 1008 standard that ensures all components work together safely and reliably as a unit. Despite this fact, there are occasions where non-UL 1008 transfer switching solutions can be used; the data center is typically - but not always - one such case. On other occasions, however, it is both appropriate and required to use a listed transfer switch, particularly when adherence to the following NEC articles is required:
- Article 517 (Health Care Facilities)
- Article 620 (Elevators)
- Article 645 (Critical Operations Data Systems)
- Article 695 (Fire Pumps)
- Article 700 (Emergency Systems)
- Article 701 (Legally Required Standby Systems)
- Article 702 (Optional Standby Systems)
- Article 708 (Critical Operations Power Systems).

Additional requirements may be imposed by the following codes and standards:
- NFPA 110, Standard for Emergency and Standby Power Systems
- IEEE Std 446-1995 – IEEE Standard recommended practice for emergency and standby power systems.

ABB has an array of products that support transfer schemes using ATS/STS (UL 1008) multiple source switchboards (UL 891) and switchgear (UL 1558) or even industrial control panels (UL 508A). Ultimately, the professional engineer and authority having jurisdiction (AHJ) will be the ones to decide whether your specific application requires a UL 1008 label, or if the transfer solution may be integrated into another piece of UL listed equipment.

Standards & Classifications

- **UL 1066:**
  Standard for Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures
- **UL 489:**
  Molded Case Circuit Breakers
- **UL 98:**
  Enclosed and Dead-Front Switches
- **UL 60947-4-1: Low voltage switchgear and controlgear - part 4-1:**
  Contactors and motor-starters-Electromechanical contactors and motor-starters
- **UL 1008** Transfer switch equipment:
  Automatic Transfer Switches (ATS) and Static Transfer Switches (STS)

Withstand and Closing Ratings (WCR)
The NFPA 110 Standard for Emergency and Standby Power Systems, Section 6.3.2, requires that the capacity and rating of automatic transfer switches be sufficiently sized to withstand the thermal and electromagnetic effects of the short circuit currents that may occur in the electrical system. It is important to compare the withstand close rating (WCR) of the switch to the available short circuit (fault) current of the system to ensure the protective device safely clears the fault.

System failure, fire, injury to personnel or damage to equipment may result unless a transfer switch has adequate withstand capability. To create a well-designed installation, the interrelationship between the protective device, transfer switch and system must be clearly understood.

As of the most recent issue, UL 1008 7th edition has updated and clarified its labelling procedure and includes three rating categories for transfer switching equipment:
- Current Limiting Fuse
- Specific class (trip time) of molded case circuit breakers
- Time-based rating: an umbrella rating restrict-ing the time in seconds that TSE must with-stand

For specific information on how ABB addresses these different rating categories, please see the link to reference [3] at the end of this document.

Automatic Transfer Switch typologies

Open Type

Open type ATS solutions require integration into a finished piece of UL listed equipment, inclusive of enclosure and certified by a nationally-recognized testing laboratory (NRTL).

Switching technology	**Switches**		**Contactors**	**Circuit breakers**	
	OT_C Range	**TruONE ATS**	**AF contractors with relays**	**Emax 2 and Tmax XT with controller**	**Embedded ATS**
Transition types	Delayed [1]: **I-0-II**	Open: **I-II** Delayed [1]: **I-0-II** In-phase monitor	Open: **I-II** Delayed [1]:**I-0-II**	Varies depending on controller	Delayed [1]: **I-0-II** Closed: **I-I+II-II** Synchrocheck
Standards	UL98 IEC 60947-3 GB/T14048.11	UL 1008 IEC 60947-6-1 GB/T14048.11	IEC/UL 60947-4-1 GB/T14048.4	UL1066, UL489 IEC 60947-2 GB14048.2	UL1066 IEC 60947-2 GB14048.2
Controlling methods	**Manual Transfer Switch**	**Automatic Transfer Switch**			

1) Delayed transition is also known as Open transition with stable OFF between positions I and II

Manual Transfer Switch (MTS) – Open-type, UL 98 listed manual transfer or "changeover" switch. Manually operated, with no automatic transfer function.

Contactor-based ATS - compact and affordable transfer schemes with high switching life for use in highly unreliable power grids with frequent outages.

Breaker-Based ATS - a combination of an ABB or third-party ATS controller (example: GE Multilin MX350) and circuit breakers such as ABB Tmax XT (UL 489) or Emax 2 (UL 1066). A breaker-based transfer scheme may also be implemented using a programmable logic controller (PLC), or even using the custom logic available in the breaker's software.

Embedded ATS - Circuit breaker-based solution using the embedded ATS features of Emax 2 air circuit breakers. For use in switchboards or main distribution boards (MDBs).

Integrated ATS (TruONE) - Open-type, UL 1008 listed, integrated device with modular, replaceable components and the fewest field wiring connections.

Enclosed Type

These ATS are finished equipment, inclusive of an enclosure and ready to install by a licensed contractor. They are UL 1008/1008S listed and no additional NRTL certification is required prior to use.

Enclosed ATS - off-the-shelf, UL 1008 Listed solutions. Ready to install.

Switching technology	Switches / Power contactors [1]		Solid State
	 Zenith ZTG	 Zenith ZTS	
Transition types	Open: **I-II** Delayed [2]: **I-0-II** In-phase monitor	Open: **I-II** Delayed [2]: **I-0-II** Closed: **I-I+II-II** Bypass withdrawable In-phase monitor	Break-Before-Make Sub-cycle Transfer Bypass
Standards	UL 1008 IEC 60947-6-1 [3] GB/T 14048.11 [3]	UL 1008 IEC 60947-6-1 GB/T 14048.11	UL 1008S IEC 60947-6-1 GB/T 14048.11
Controlling methods	Automatic Transfer Switch		Static Transfer Switch

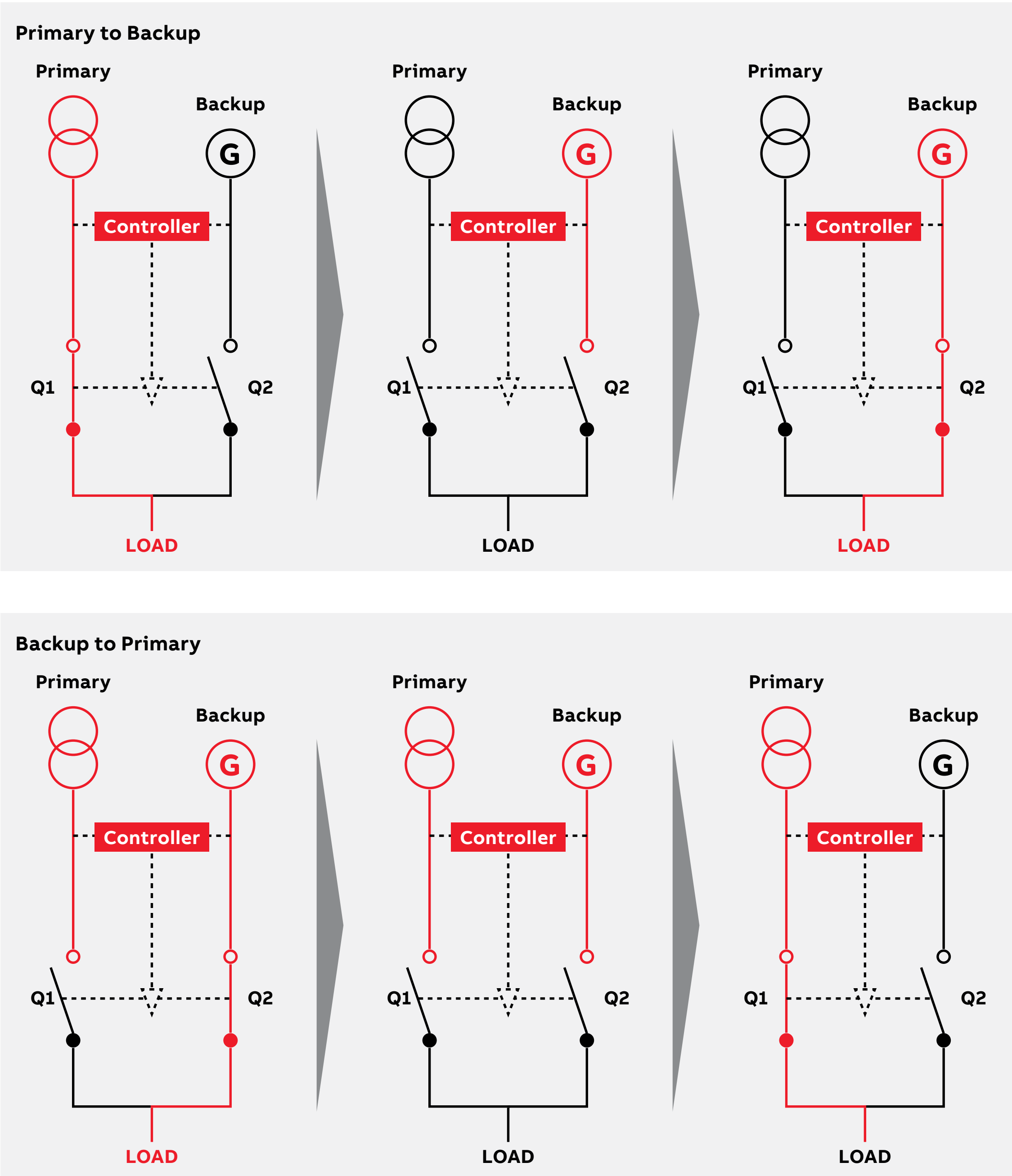
1) Zenith and TruONE are also known as power contactor-based solutions in NEMA/UL market
2) Delayed transition is also known as Open transition with stable OFF between positions I and II
3) IEC 60947-6-1 and GB/T 14048.11 certification is available for the current range 1600...3000 A

Supported Transfer Schemes

Delayed transition (I-O-II)
- Also known as open transition with a stable OFF between positions I and II
- Commonly preferred transition type in IEC markets
- Operation is independent of electrical synchronization between both power sources
- Mechanical and/or electrical interlock is required to prevent contacts from overlapping
- Time delay in OFF position prevents high current and high torque transients from occurring in the case of inductive load transfer (pump stations, water treatment plants, manufacturing facilities).

Application: two power interruptions (transfer to emergency power source and during re-transfer) lasting seconds are acceptable, otherwise a UPS is installed to cover the downtime.

Delayed Transition [1] – Transfer sequence MAIN-GEN

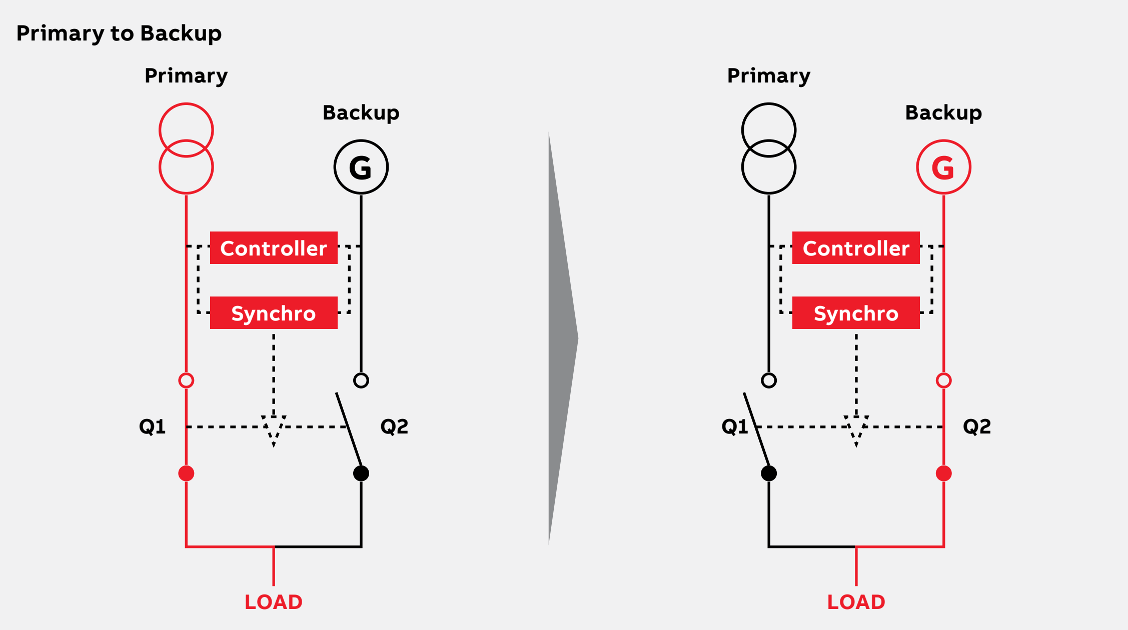


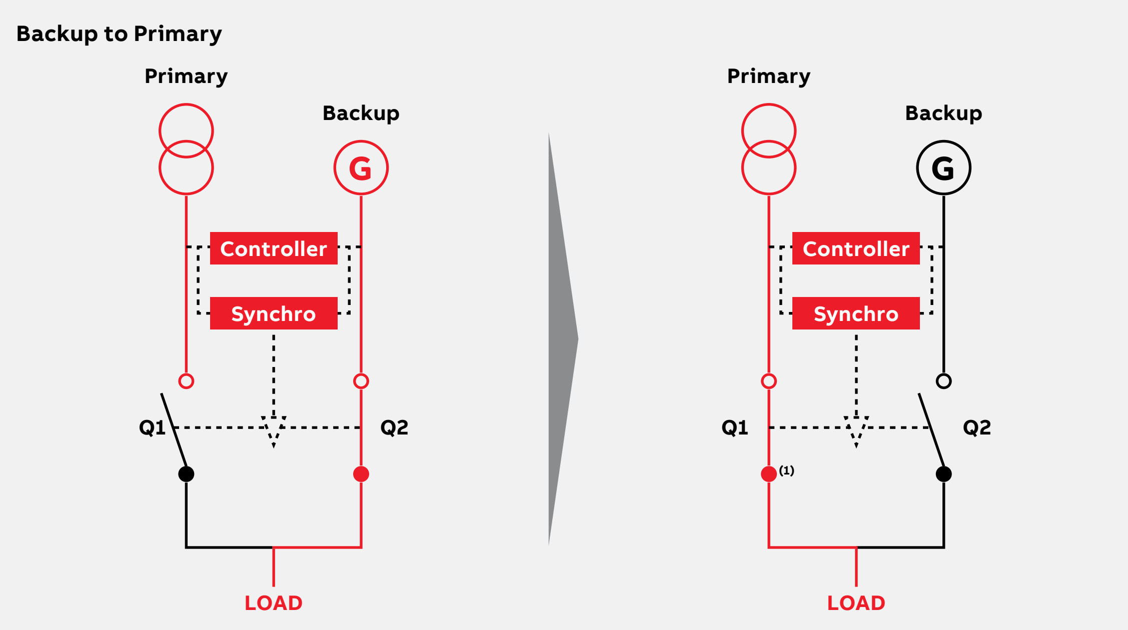
1) Delayed transition is also known as Open transition with stable OFF between positions I and II

Open Transition (I-II)
- Preferred transition type in North American markets
- The transfer switch must be equipped with in-phase monitor to facilitate synchronization before switching from backup to primary power
- Transfer will not occur if both power sources are available, but unable to meet synchronization criteria
- Rapid contact transfer time < 50 ms from backup to primary power source (when both sources are available). Transfer is accomplished without appreciable interruption in the power delivered to downstream loads.

Application: loads are not sensitive to brief power interruptions lasting less than 50 ms (small businesses, residential installations without sensitive loads and systems with a downstream UPS).

Open Transition – MAIN-GEN transfer sequence



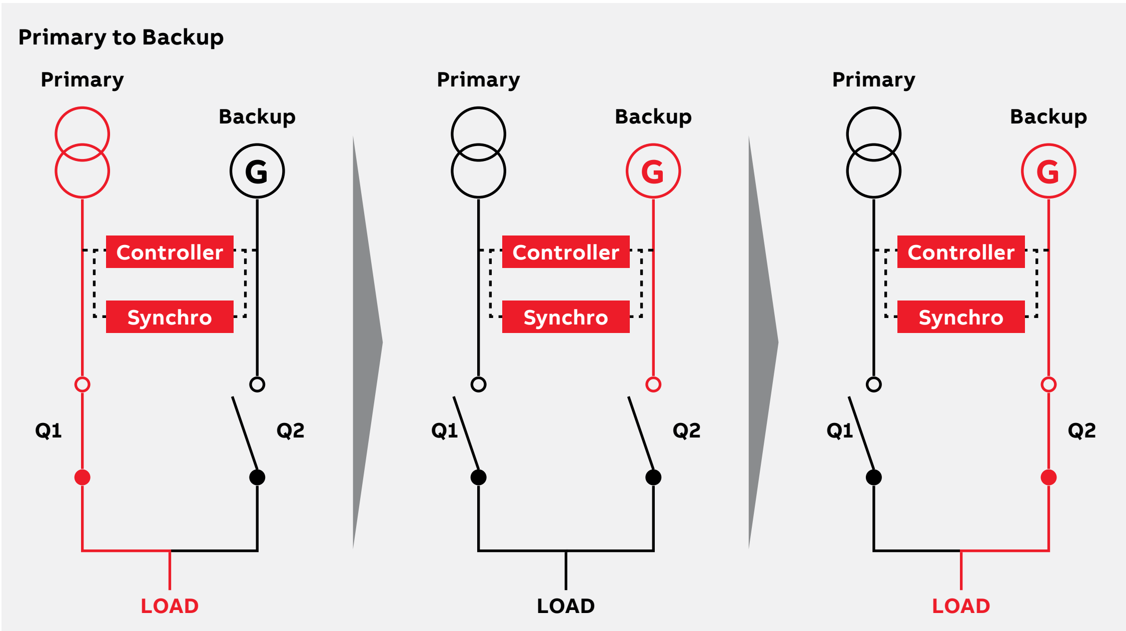


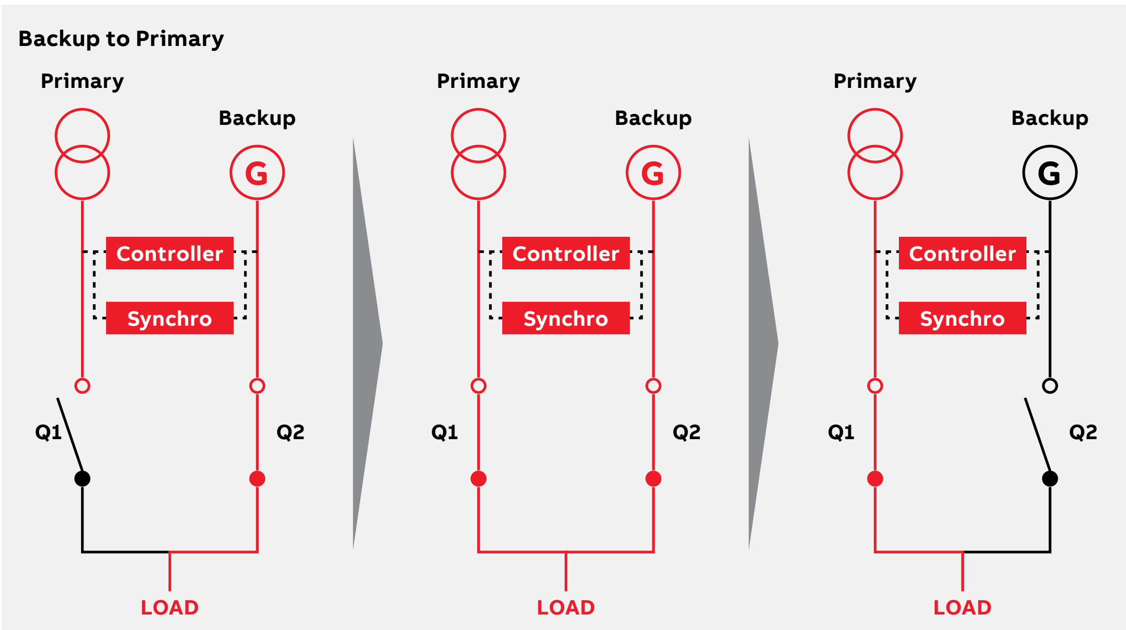
1) Supply interruption up to 50ms

Closed Transition (I – I+II – II)

- Closed transition ATS use a passive synchronization scheme (ATS does not control the source) to ensure the voltage frequency and phase angle are within the specified limits for closed transition switching.
- Closed transition eliminates power interruptions during re-transfer from backup to primary power, when both power sources are available
- Some utilities require closed transitions to comply with interconnect requirements
- Closed transitions can produce higher fault current due to concurrently connected power sources
- Generally, a more expensive transfer scheme.

Closed Transition – MAIN-GEN transfer sequence





Open vs. Closed Transition

Since an open transition transfer scheme also requires synchronization, the user may wonder what the difference is between open and closed transition types.
The difference lies in the overlapping / non-overlapping power contacts for closed versus open transition. Switch contacts take time to open and close, so, in addition to the time required for the switch to find the synchronization point, there is a finite duration where the switch contacts are in motion. While switching, there is a finite power interruption for open transition ATS (up to 50ms, or 3 cycles), while the closed transition switch has temporarily, concurrently closed contacts that prevent any interruption in supply to the load when transferring power from backup to primary source.

Event Summary for Transition Types

Event	Delayed (I-O-II)	Open (I-II)	Closed (I-I+II+II)
Loss of primary power	No power to load detected. Cue transfer event		
Transfer: primary → backup	Outage time depends on backup power source: • Generator: <30 seconds, typical • UPS, energy storage: immediate • Alternate utility source: immediate		
Primary power restored	Primary power source detected. Cue transfer event back to primary; subject to user-defined countdown/delay (15 minutes is common, to prevent transfer prior to grid re-establishment)		
Re-transfer: backup → primary	Transfer w/ time delay (t_d) in the stable off (O) position. $t_{total} = t_d + t_s$ where t_d set by user, t_s is contact switching time	Transfer is synchronized between primary and backup sources. $t_{total} = t_{sync} + t_s$ where t_{sync} is the time to synchronize, t_s is contact switching time. $t_{total} < 50$ ms.	Transfer is synchronized between primary and backup sources. No time delay. Overlapping of power contacts lasts 100-200ms.

Automatic Transfer Switch Configurations using ABB Products

Grid layouts / Transition type (1)(3)	Contactors	Switches			Circuit Breakers	
	Relays	TrueONE	Zenith ZTG	Zenith ZTS	Embedded ATS (Emax 2)	ACB/MCCB + controller
Main-Main	Open, Delayed (1)	Open, Delayed (1)	Open, Delayed (1)	Open, Delayed (1), Closed	Delayed (1)	Varies
Main-Gen	Open, Delayed (1)	Open, Delayed (1)	Open, Delayed (1)	Open, Delayed (1), Closed	Delayed (1)	Varies
Gen-Gen	-	-	-	Open, Delayed (1), Closed	-	-
Main-Tie-Main	-	-	-	-	Closed	Closed
Main-Tie-Gen	-	-	-	-	-	-
Main-Main-Main	-	-	-	-	RTSE (2)	-
Main-Main-Gen	-	-	-	-	RTSE (2)	-

1) Delayed transition is also known as open transition with stable OFF between positions I and II
2) Remote transfer switch equipment, mechanical interlock available. ABB does not provide ATS controller for 3 power supply applications
3) S TS use silicon controlled rectifiers (SCR) to perform a sub-cycle break-before-make transfer which is the most similar to an ATS open transition.

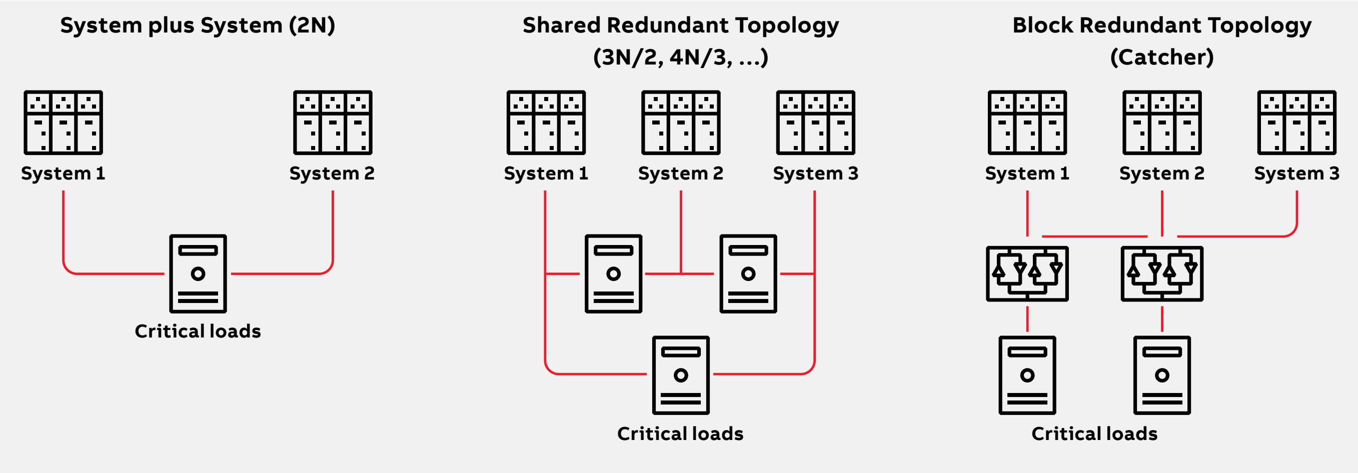
Circuit Topology

Various power circuit topologies are used in data centers, depending on the availability and serviceability requirements of these latter. While a private data center for a small-medium-sized business may accept lower uptime assurances, most commercial colocations, critical facilities, government, enterprise, and hyperscale data centers require higher uptime guarantees and fault tolerance. A comparison between data center service levels is given below.

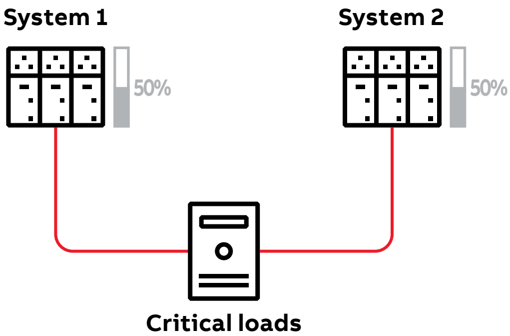
Component Redundancy	**None**	**Partial power and cooling redundancy**	**Full N+1**	**Fault tolerant, redundant; 2N or 2N+1**
Estimated Uptime	99.671%	99.741%	99.982%	99.995%
Downtime per year	< 28.8 hours	< 22 hours	< 1.6 hours	< 26.3 minutes
Concurrently maintainable	No	No	Partially	Yes
Price	$	$$	$$$	$$$$
Compartmentalization	No	No	No	Yes
Staffing	None	1 shift	1+ shift	24/7/365
Typical Customer	Small companies and startups with simple requirements	Small-medium sized businesses	Growing and large businesses	Government entities and large enterprises
Main benefits	Most affordable	Good cost-to-performance ratio	Higher performance and availability	Fault-tolerance for high traffic, high value networks

Lastly, there is a large jump in data center availability in full N+1 and redundant system architectures (2N, 2N+1, etc.). In addition, modern, large-scale data centers are typically configured as both fault tolerant and concurrently maintainable (2N and similar), so it is best to focus on these examples. These architectures will now be explained along with schemes that share resources, to provide an optimal trade-off between economics and reliability.

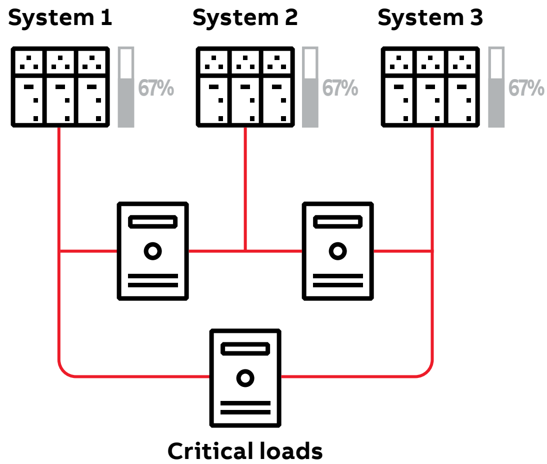
System Architectures



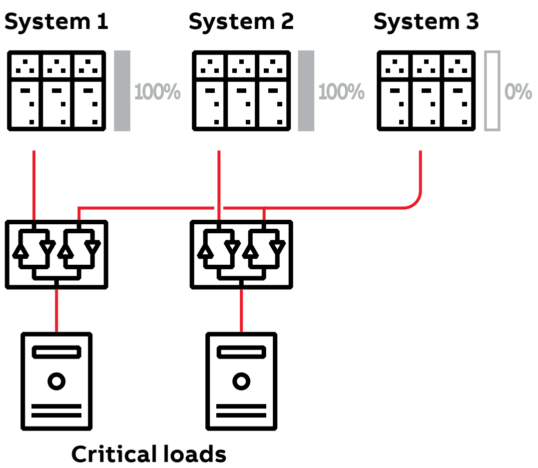
System plus System (2N)
The system plus system or 2N topology applies an identical copy of the power distribution system to a single set of IT loads. Each system comprises a utility and backup power source with transfer scheme in the main distribution board, UPS, PDUs and is loaded at 50% of nameplate capacity. This allows an entire system to be offline for servicing, or to fail, without overloading the distribution system or interrupting the IT and mechanical loads. The basic circuit model is illustrated below:



Shared Redundant Topology (3N/2, 4N/3, ...)
The overall system is fully redundant in this architecture. However, the redundant system copy is shared by more than one resource. This allows a single "system" to fail, while 100% of the load is still supported. Sharing the redundant resource increases the power usage effectiveness ratio (PUE) and is therefore more efficient and economical to run than a 2N architecture. As an example, using 1 MW blocks of IT load, a 3N/2 system would have 3 MW of capacity feeding 2 MW of IT load. This improves utilization to 66%, less non-IT loads (take 100% / (3/2) = 2/3 = 67%). Similarly, 4N/3 improves utilization to roughly 75%. The 3N/2 shared redundant configuration is shown below:



Block Redundant Topology (Catcher)
Block redundant, also known as "catcher" topology, utilize a static transfer switch (STS) to transfer the critical load from the primary or active system to the reserve or catcher system. The active UPS can be loaded to full capacity. The reserve UPS has no load in normal operation. The reserve system can be larger than the active system. Utilization as high as 80% can be achieved (less non-IT loads) in the catcher configuration. In this case, an STS is required instead of a conventional ATS to respond to power interruptions at subcycle (<16 ms) level. A catcher system can be applied with single-corded or dual-corded IT loads.



Reference architectures

Everything - from the basic concepts of automatic transfer switches to the applicable code and standards regime, and the products and circuit architectures in which they can be used - has already been explained in the previous pages. This section explains the role played by the ATS in data center power distribution systems. You should now be familiar with certain concepts, such as withstand and closing ratings (WCR) and the differences between automatic and static transfer switches.

To assist the you further and guide you through your next design, we have assembled the following reference architectures for each of the system architectures shown above.
The reference designs provide concrete examples, inclusive of detailed schematics and product suggestions to give you a framework for designing redundant power systems using ABB transfer switch equipment and other data center-related products.
The following reference architectures are outlined in the next pages:

Design Description	Key Features
ATS in Redundant (2N) Data Centers	2N. Double-corded loads, fully redundant, concurrently maintainable
ATS in Shared Redundant (3N/2) Architectures	3N/ 2. Double-corded loads, shared redundant resources, concurrently maintainable
ATS in Block Redundant (Catcher System) Architectures	Catcher System. High system utilization ratio, shared reserve system using STS, concurrently maintainable

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Characteristic Electrical Quantities

While the circuit configurations and total data center power requirements may vary, each of the reference architectures are designed around a single “system” unit or power block of roughly 2.5 MVA. Variations to the circuit architecture configure these blocks in different ways to achieve the desired level of utilization.

Description	Value	Units
Overall system capacity (per block)	2.5	MVA
IT Loads	1.6	MVA
Cooling and mechanical loads (chiller, CRAC, misc ; N+1 configuration)	0.9	MVA
“System” total count (z) for 2N, 3N/2, catcher	2, 3, 4	-
Nominal System Load for 2N, 3N/2, catcher (IT ONLY)	0.8 (50%), 1.1 (67%), 1.2 (75%)	MVA (%)

System Main Distribution		
Primary Voltage	480	VAC
Transformer Rating (T1)	2	MVA
Transformer Impedance (Z)	5%	%
Minimum SCCR / overall prospective short-circuit current	60	kA
Generator Rating (G)	2.5	MVA
Main Distribution Board Bus Continuous Current	3000	A
Main Distribution Board Bus / OCPD rating	4000	A
IT Loads		
Primary Transfer Switch Rating	2000	A
UPS Rating	1.6	MVA
Secondary Distribution Board Bus Continuous Current	2000	A
PDU Nameplate Power	0.8	MVA
PDU Input Voltage	480	VAC
PDU Continuous Input Current	1000	A
PDU count / system (x)	2	-
PDU Output Voltage	120V/208Y	VAC
RPP Voltage Rating	120V/208Y	VAC
PDU Output Current	2300	A
RPP Continuous Current Rating	400	A
RPP count / PDU (y)	6	-
Cooling and Mechanical Loads		
Cooling and Mechanical Operating Voltage	277V/480Y	VAC
Secondary Transfer Switch Rating	100	A
Secondary ATS count	20	-
Chiller ATS count (n)	5	-
CRAC ATS count (m)	5	-
Misc mechanical, fire and emergency lighting	10	-

Equipment Selection

Reference	Part Number	Description
MDB	(*)	ABB Reliagear Switchboard
ATS (IT LOADS)	(*)	ABB Breaker-based ATS using Emax 2 ACB, Zenith ZTG or ZTS
UPS	(*)	ABB Megaflex UL 1.6 MW
SDB	(*)	ABB Reliagear Switchboard
PDU	(*)	ABB TruFit PDU
RPP	(*)	ABB or 3rd party RPP
ATS (MECHANICAL)	(*)	ABB TruONE, Zenith ZTG or ZTS
STS	(*)	ABB Cyberex SuperSwitch 4 Static Transfer Switch ("catcher" system ONLY)

*) Please use the Empower Quote system’s configurators to select your specific configuration options

Using the common building block of a 2.5 MVA “system,” we’ll now iterate through several configurations to generate the proposed circuit architectures.

ATS Selection

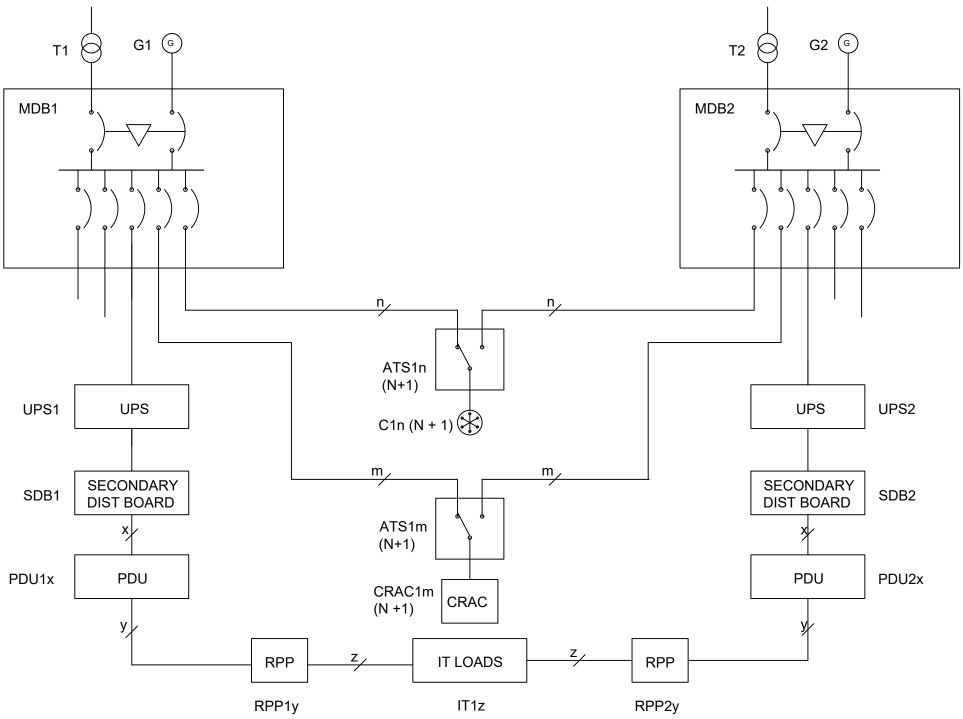
This is a white paper discussing ATS solutions, so let's take a closer look. ATS are necessary for both IT loads and the various cooling, critical power (fire & emergency lighting) and mechanical loads. We will now discuss these briefly.

Either an external ATS or a switchboard-integrated transfer scheme may be suitable for the IT loads. Product lines are recommended in the Equipment Selection table above. The advantage of a transfer solution in the main distribution switchboard (MDB) is that it requires fewer circuit breakers, reduces connection complexity and therefore reduces the total cost and overall footprint of the installation. Many breaker-based solutions can accommodate a variety of transfer schemes, such as delayed transition using ABB "custom logic" or delayed and closed transitions using ABB's Emax 2 Embedded ATS. The breakers can also be controlled by a dedicated ATS controller or even a PLC. The trade-off compared to using an enclosed ATS is that breaker solutions require greater consideration as to system design, compliance, and integration. Conversely, external, enclosed ATS (Zenith ZTG/ZTS) are turnkey products, UL 1008 listed and feature proven robustness. They may also offer additional features such as a withdrawable bypass (Zenith ZBTS). Please revisit pages 5 and 6 for specific details about the features and ratings of the various ABB ATS offerings.

The user may elect to use the open-type TruONE ATS or the enclosed Zenith ZTG or ZTS series for the miscellaneous cooling and critical loads. TruONE is advantageous due to its incredibly small form factor. In fact, several chiller vendors already include these ATS in dedicated chiller distribution panels (another option). Again, an enclosed solution requires less consideration as to design and is ready to go, out of the box. Note that Zenith ZTG and ZTS already include TruONE for ratings up to 1200A (UL) for open and delayed transition schemes. So whether it is part of an application-specific panel, open-type or enclosed ATS, users can enjoy the benefits of TruONE ATS for their supporting loads in a variety of use cases within the 30 to 1200A range.

Reference Design: ATS in Redundant (2N) Data Centers

We'll start with the 2N, fully redundant circuit topology. The power system consists of two complete distribution systems, which addresses redundancy. Each system includes a transfer scheme to switch power between different utility sources and backup power sources (generators). From here, smaller circuits feed cooling loads (chillers and computer room air conditioning or CRAC), inclusive of accompanying ATS, which are critical to ensuring continuous cooling, preventing additional costs and the risk of damaging the IT loads. Note that the additional mechanical loads (ventilation, humidifier/dehumidifier), fire pump and suppression, and emergency lighting are not shown, but follow a similar connection scheme. Since IT loads have small and finite energy reserves, their continuous operation is ensured by an uninterruptible power supply (UPS), with the following power distribution equipment downstream: secondary distribution board (SDB), power distribution units (PDUs) and remote power panels (RPPs).

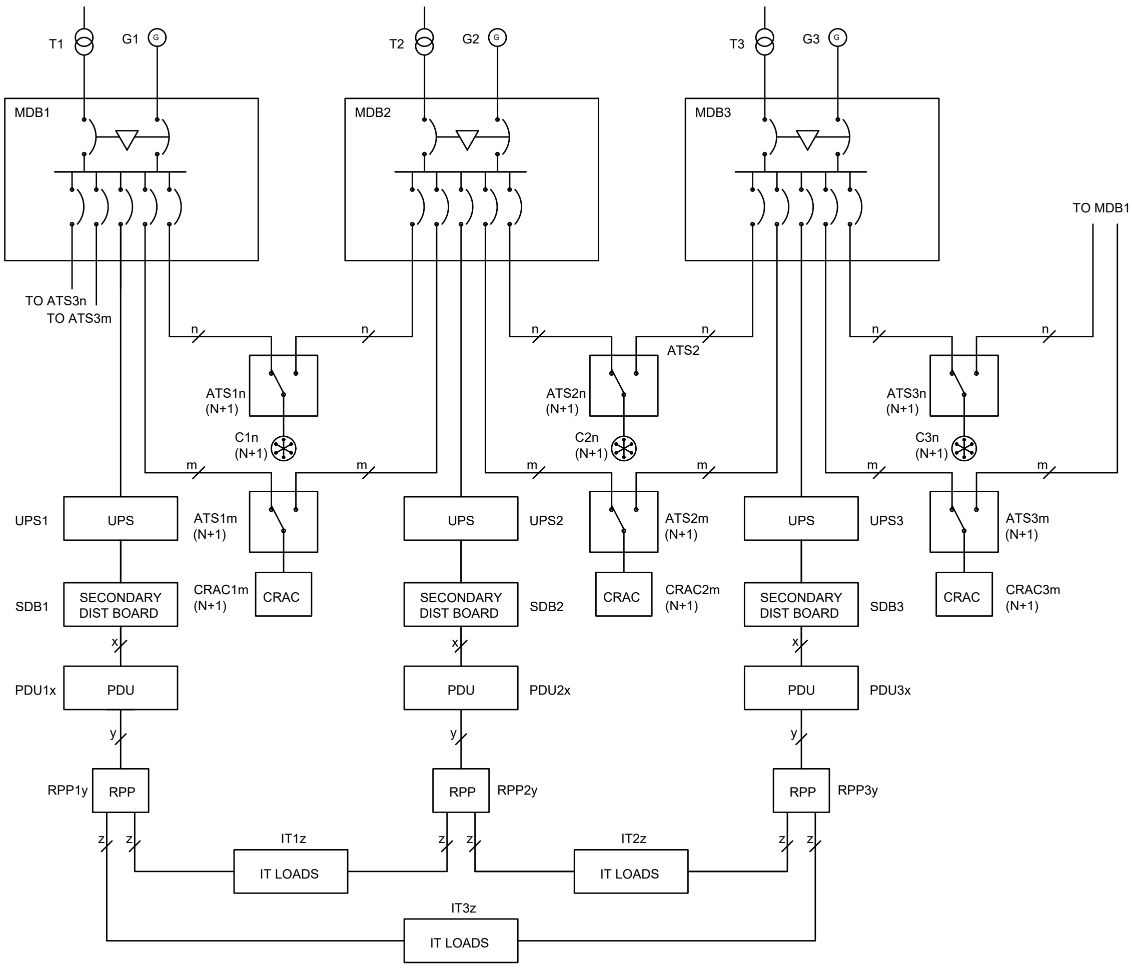


Each system block is centered around several key components. The first are automatic transfer switches. Both enclosed and open type ATS can be used, depending on the level of integration and customization required. For the open type, the ABB TruONE ATS is capable of up to 1200A for a single voltage range of 200-480VAC (three-phase). As to enclosed ATS, the customer can choose ABB Zenith ZTG, ZTS or ZBTS with the optional bypass feature; these support 30-3000A up to 480VAC. As shown, the system uses the breaker-based transfer scheme enabled by ABB "custom logics," all from within the main distribution board. The breaker-based solution is often desirable due to its reduced cost and smaller footprint.

For continuous power, we have chosen the 1.6MW Megaflex UL UPS. This is a special UPS than enables scalability of the facility thanks to its modular construction. As more or less power is required, 400kW modules turn on and off, ensuring optimal conversion efficiency even at fractional loads (<100%) of the UPS' nameplate rated power. The UPS should be equipped with a static bypass feature enabling it to continue to provide power if its conversion module(s) fail. With duplicate systems, backup power sources and UPS equipped with static bypass, the 2N (and subsequent architectures) is hardened to multiple failures of both equipment and supply.

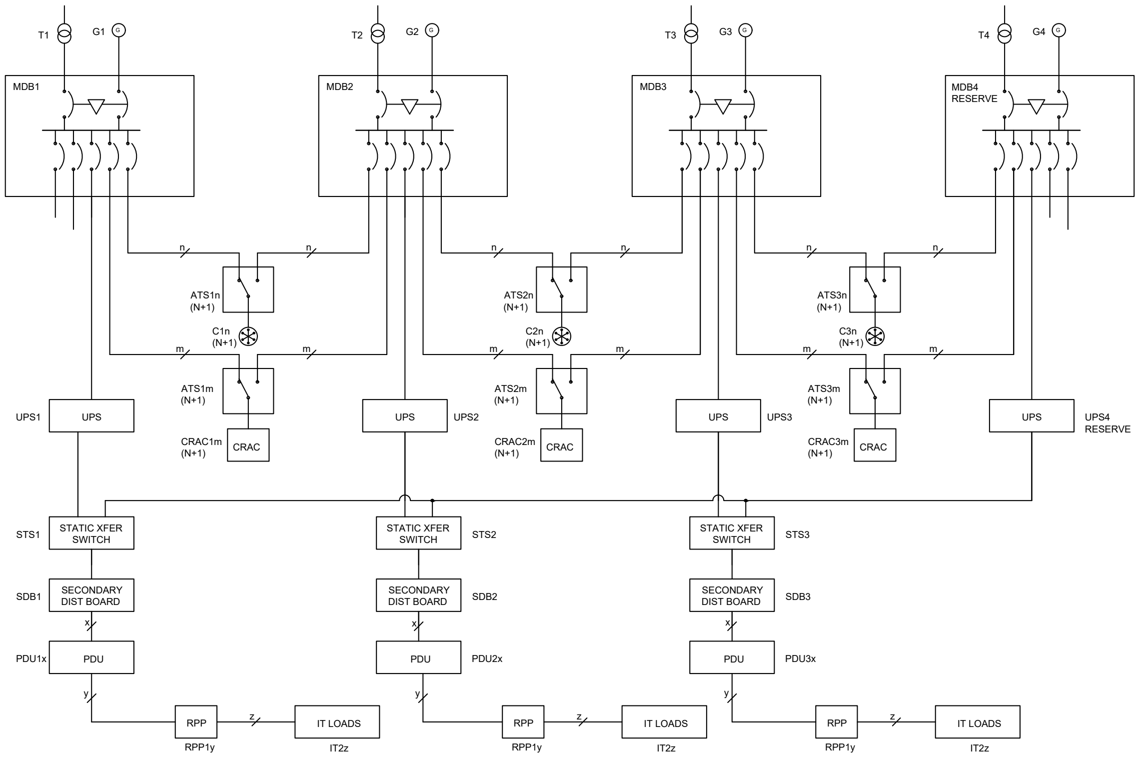
Reference Design: ATS in Shared Redundant (3N/2) Architectures

In the shared redundant system, an additional system block has been included and the system has been wired so that, should any one system fail, the remaining two resources are able to continue to support 100% of the loads. This system trades some redundancy for greater utilization of the power system's assets. The diagram of this sort of design is given below:



Reference Design: ATS in Redundant (Catcher System) Architectures

This final architecture features three primary systems that operate at 100% of their nameplate rating, with a catcher or “reserve” system on standby to instantaneously pick up any dropped load. The configuration uses fewer resources than the 2N or 3N/2 designs and can achieve higher levels of utilization. This is obtained through use of a high-tech piece of equipment: the static transfer switch, which is required for its sub-cycle switching time.



Product offering

ABB TruONE ATS:

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CATALOG

ABB Zenith ZTS Enclosed ATS:

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ABB Zenith ZTG Enclosed ATS:

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ABB Reliagear Switchboard:

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ABB TruFit Power Distribution Units (PDU):

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ABB Cyberex SuperSwitch 4 UL Static Transfer Switch (STS):

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Emax 2:

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ABB MegaFlex UL UPS:

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Additional Resources

Ref	Document type, Title
[1]	Keeping the world's power flowing. ABB Transfer switch solutions overview
[2]	Designing scalable, modular digital data centers
[3]	TrueONE ATS – Withstand and Closing Ratings (WCR)

Abbreviations:

Acronym	Description
ACB	Air Circuit Breaker
ATS	Automatic Transfer Switch
CB	Circuit Breaker
IT Load	Information Technology Load (Computers/Servers)
MCCB	Molded Case Circuit Breaker
MDB	Main Distribution Board
PDU	Power Distribution Unit
RPP	Remote Power Panel
RTSE	Remote Transfer Switch Equipment
SDB	Sub-Distribution Board
STS	Static Transfer Switch
TSE	Transfer Switch Equipment

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