ULTIMATE SERVICE ASSOCIATES
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The ultimate solution for maintaining your nationwide generator network

# Automatic Transfer Switches (ATS) - Function, Operation & Guide to Selection

## 1.0 Introduction:

An Automatic Transfer Switch (ATS) is a device that, as its name states, automatically transfers the primary electrical power input (usually the utility grid) to a backup source of electrical power (frequently an engine-driven generator system). There are various types of ATS and different methods for transferring power between primary and secondary power sources. The automatic element of the ATS is initiated when sensors detect the prime power has failed or is outside predetermined parameters. A high percentage of users select an ATS over a manual bi-pass switch because an automatic transfer eliminates the need for operator intervention, especially when tolerance for any power interruption can be measured in seconds.

***This information sheet discusses the operation of an ATS, the function offered for standby generator systems, the importance of ensuring the load can only be fed from one power source, and the various factors that must be taken into account when selecting an ATS.***

## ATS Switching Diagrams *(Switches Mechanically Interlocked, only one switch can be closed to load)*

*Figure -1* **Typical ATS Arrangement**

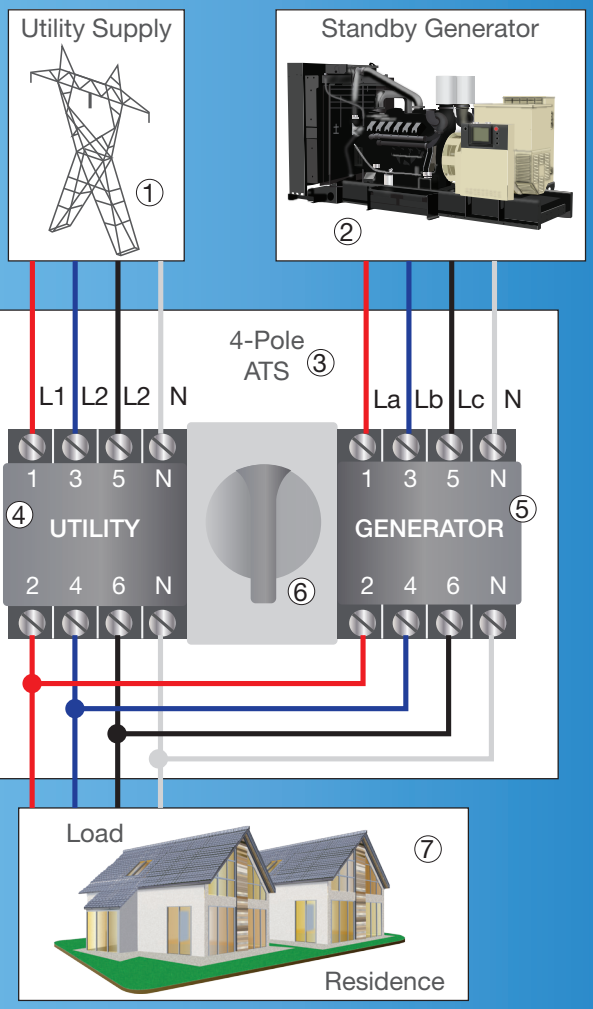
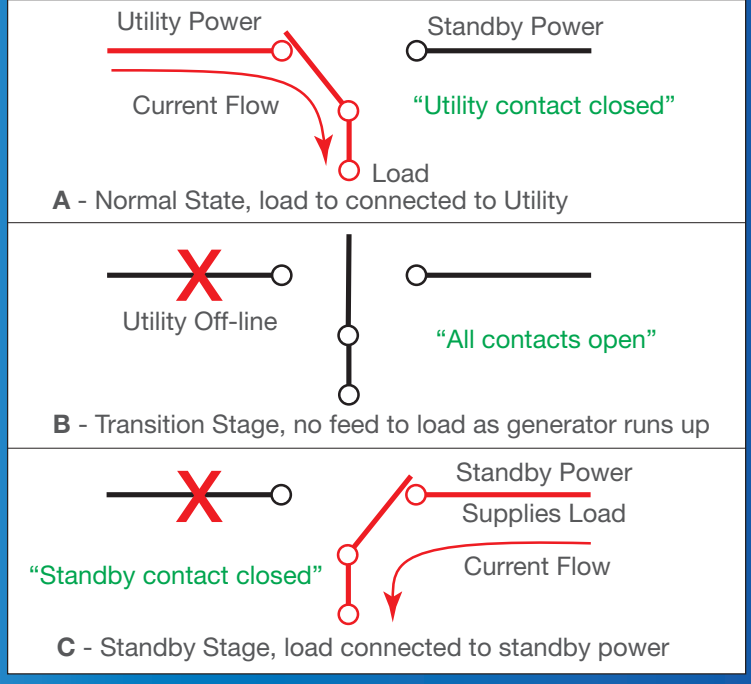



*Figure -2* **ATS Open Transition Switching** (Break before Make)




| Item | Description of Items in Figure 1 |
|---|---|
| 1 | Normal power source - usually utility (from macro or micro grid) |
| 2 | Standby generator power (most common, but could be batteries, fuel cells, etc.) |
| 3 | 4-pole ATS switching neutral (could also be single 2-pole and 3-phase 3-pole) |
| 4 | Utility switch (CB of contactor) switches mechanically interlocked |
| 5 | Generator switch (could be switch for another source of standby power) |
| 6 | Manual change over switch (overrides automatic sensors and switching) |
| 7 | Typical load |

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## 2.0 Components OF AN ATS:

An ATS functions as a set of switches that automatically transfer the connected load to the secondary (standby) electrical power supply when the primary power supply is unavailable ***(See Figure 1).*** There are various types of switches and transfer protocols, which we will cover, but principal components include:

- Primary and Secondary Power Switches - Both switches are mechanically interlocked to ensure when one switch is closed, the other switch is open. This ensures that only one power supply can feed the load, and generator power is not trying to feed the utility and vice versa. An AC circuit can only manage multiple power supplies when the individual power inputs have their AC sine waves, frequencies, and voltages in sync, which is the function of paralleling switch gear *See info sheet on this subject.*
- Control Module - As the switching process is automatic, a control module is included with the electrical circuitry to constantly monitor the voltage of the primary power source (usually the utility). This module will initiate the transfer from the primary to the secondary power source when it detects the primary source is outside the required limits. The module also includes timers to monitor the correct power availability before returning to the primary power supply.

## 3.0 Principal Types of ATS Switches:

For most residential and commercial/industrial standby power applications, there are principally two types of ATS, circuit breaker and contactor. The variations are:

### 3.1 Circuit Breaker:

The circuit breaker has two mechanically interlocked circuit breakers (CB), where one breaker can be closed at a time. The CB's ampere rating will be matched to the maximum connected load. Besides providing over current protection, the circuit breakers are tripped when voltage on their supply side is sensed to be outside pre-determined limits.

### 3.2 Contactor Type:

Electrical contacts are maintained in the closed position by solenoids energized by the power supply. On the utility side, the solenoids close the utility contacts to feed the load, and on the generator side, the contacts are energized by the power feed from the standby generator set. As for the circuit breaker switches, each set of contactors are mechanically interlocked, so only one set of contacts can be in the closed position.

The chart below (*figure 3*) details the pros and cons when selecting a contactor of CB ATS for standby applications:

| ***Figure 3*** | Guide to Selecting an ATS* | |
|---|---|---|
| ATS Type | Circuit Breaker | Contactor |
| Advantages | Provides overload protection | Simpler design |
| | Greater reliability of the less contact issues | They operate faster than CB types |
| Disadvantages | More expensive than Contactor type | No overcurrent protection |
| | Power takes transfer is longer | Additional CB's should be fitted down the line |
| * Consult with your authorized generator distributor before selecting an ATS for you application | | |

### 3.3 Other Types of ATS's:

While most ATS switch by contactors or CB's, other variants exist, such as Definite Purpose Design and Solid State. These are for specific applications defined by the characteristics of the connected load. For further details, see Information Sheet, *"Types of ATS's and Application in Generator Set Systems".*

## 4.0 ATS Transition:

In addition to the switching systems, CB or Contactors, the type of transition from the Utility and Secondary power source have to be taken into consideration. ***Figure 2***, depicts "Open Transition" the majority of residential and commercial/industrial applications up to 500kW.

### 4.1 Open Transition:

The terminology refers to switching from one supply to the other. When power from the primary supply, usually the utility grid, fails, the primary power switches have a mechanism that moves it to the open position; this applies to CB and Contactor variants. When the primary contacts are fully open, the secondary/standby power switch contacts will be closed. This is frequently referred to as "Break-Before-Make." The standard transition for most applications.

### 4.2 Other Transitions:

Other applications that do not want to have any break in the power supply while the secondary source comes online are called a closed transition transfer switch (CTTS) or "make-before-break." These applications are much more expensive because they are fitted with equipment to ensure source voltages and frequencies are in phase. There are also systems with a bypass isolator switch for critical installations. Testing can be made to standby sources, but this also is more expensive and complicated because a parallel switch gear is required.

## 5.0 ATS Single Phase and Three Phase:

Having selected the type of ATS for the application, the system designer now has to consider the power supply phase, either single or three-phase. The following applies:

### 5.1 Single-Phase:

Most single-phase applications have a 110/220-volt utility 3-wire input; in this case, a 2-pole switch switches both hot wires, and the neutral is solid.

### 5.2 Three-Phase:

For a 3-phase 4-wire systems, either a 3-pole switch is selected, whereby each hot wire is switched, and the neutral is solid, or a 4-pole is selected if the neutral is also switched. See Information Sheet, *"When to Switch the Neutral."*

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