ALPHA ESS TECHNICAL NOTICE

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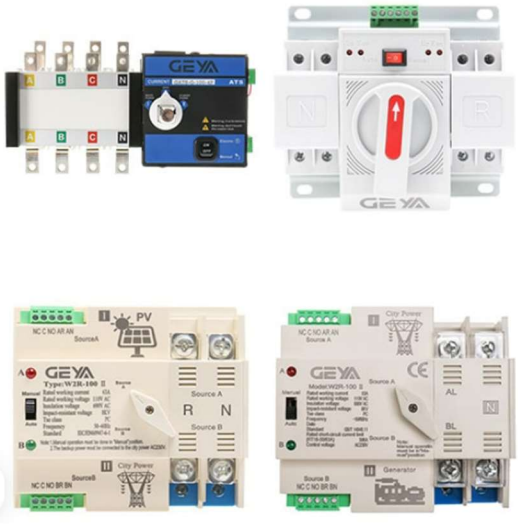
Relevant to Models	All Battery Systems with Backup Circuits

CHANGEOVER SWITCHES AND BATTERY BACKUP – WHY US A CHANGEOVER SWITCH?



A Battery System with a Backup output is designed to provide power to the Backup Circuits during a grid failure, while simultaneously *isolating* those powered circuits from the Grid.

The Backed-up Circuits MUST be isolated from the Grid in the event of a Grid Outage. This is a requirement of AS4777 but is also a logical requirement, since the Grid may have been deliberately shut off to allow technicians to work on the power lines. Any feed-in from live circuits still connected to the grid could injure the power line workers.

The problem with any Backup Circuit powered by a Battery System is that the circuit always runs through the Battery Inverter. If the Battery Inverter ever has a fault, it is possible that the Backup output fails *even when the grid power is still present*. In practice, this means that the backup circuits of the house do not work, even though the normal, non-backed-up loads in the house are all still working.

This is the exact opposite of what anyone wants. Important circuits don't work, and the unimportant ones are fine.

Alpha recommends the use of appropriate Manual or Automatic Transfer Switches when any backup system is connected in the house.

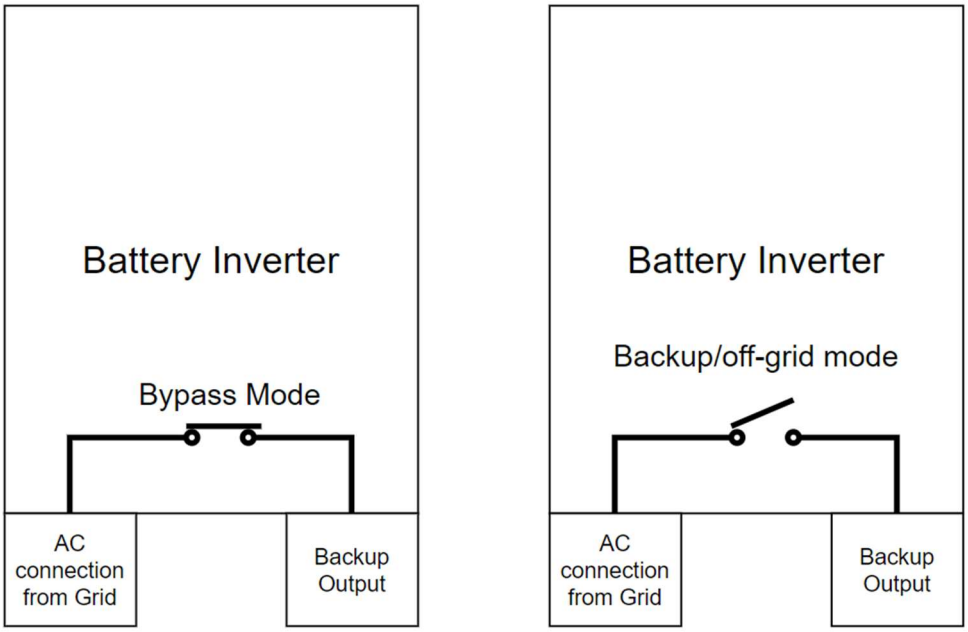
MURPHYS LAW AND BACKUP CIRCUITS

Anything that can go wrong, will go wrong. That's Murphy's Law. An immutable Law of Electrical Work is that it will go wrong on a Friday night and your customer will call you, screaming that something needs to be done immediately.

Losing power to the circuits that a customer deemed to be their most important is a sure way to ignite the ire in even the most tolerant homeowners.

THE PROBLEM

Batteries with Backup Circuits typically run in two modes: Backup and Bypass. (we'll ignore those dopey designs where the backup is *only* active in a blackout – that's a poor solution which no one should support).



In Bypass mode, the Grid Supply is directly passed through to the Backup output. The easiest way to confirm this is to measure the Backup output voltage – it will match the Grid Supply voltage.

In Backup Mode, the bypass switch opens, and the backup output is then supplied directly from the inverter. In this case, the output voltage will be an incredibly stable 230v

The problem is that, if the inverter develops a fault, the Grid Supply may not be available at the Backup output terminal (e.g. if the Inverter main circuit board fries itself), so the "essential circuits" of the house would be unpowered, even though the Grid is operating normally.

TRANSFER AND BYPASS SWITCHES

A Transfer Switch is a switch designed to provide power to a Load Circuit from one of two supplies.

A Bypass switch is any mechanical switch that allows a circuit to be bypassed. In the case of a Battery Backup, a Bypass Switch could be as simple as an MCB and a wire connecting the Main Switch to the backed-up load circuits.

A Changeover Switch is a bit murky in terms of how it is defined, since it includes switches with a "Centre off" as well as switches without.

What's the difference between these three switches?

A Bypass switch can cause a lot of problems if the "easy" option is taken. If a simple MCB is used, the Bypass switch allows a direct connection from the Backed-up loads to the grid supply. Unfortunately, this does NOT interrupt the output from the Backup terminals on the battery inverter. This means that the Backed-Up loads are connected in parallel to the main switch and to the Backup output of the inverter.

Ideally, the Bypass MCB, which bypasses the battery and connects the Loads straight to the Grid Supply from the Main Switch, is normally off/open. It would only be used if the Backup output from the Inverter failed (ie the inverter developed a fault) and the Grid was still on.

The danger here is if the end-user flicks this MCB to "bypass" when there is nothing wrong with the inverter. If the Grid was then disconnected to allow works to be carried out on the lines, the Backup of the Battery Inverter would kick in and power the backup circuits. With the end-user closing the "Battery bypass" MCB, there would be a circuit back to the main switch, meaning the Battery Inverter will be energising not just the Backed-Up loads, but also the Grid and potentially that poor Linesman working on the pole out the front of the house.

Simple "Bypass" switches should not be used.

A Changeover switch with simple Normally Open and Normally Closed contacts (i.e. no "centre off"), is also a poor solution since it does not have a "break before make" function (more information later). For simplicity, we will refer to a "Changeover" switch with a "break" function as a manual Transfer Switch.

The Transfer Switch is a better solution, being an "either/or" switch. As in the diagram in Figure 1, a Transfer switch selects between two Supplies. Either the Grid *or* the Backup supplies the Loads.

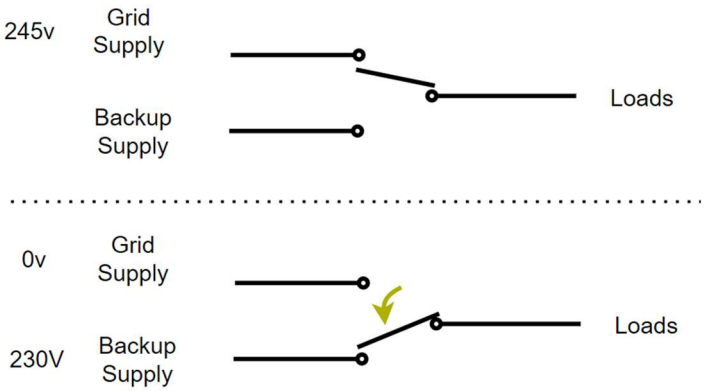


Figure 1 - Transfer Switch

AUTOMATIC VS MANUAL

A Transfer switch can be Manual or Automatic. A manual transfer switch involves the end-user having to turn or activate a switch mechanism, selecting either the Grid or the Battery Backup.

An Automatic Transfer Switch (ATS) takes this one step further, automatically detecting the loss of voltage on the Grid Side and then "checking" for voltage on the backup terminals. If there is voltage on the Backup side, the ATS will move across to the backup supply and break the connection to the Grid.

The moment the Grid re-connects, the ATS will transfer back to the Grid supply for its connection, disconnecting from the backup supply.

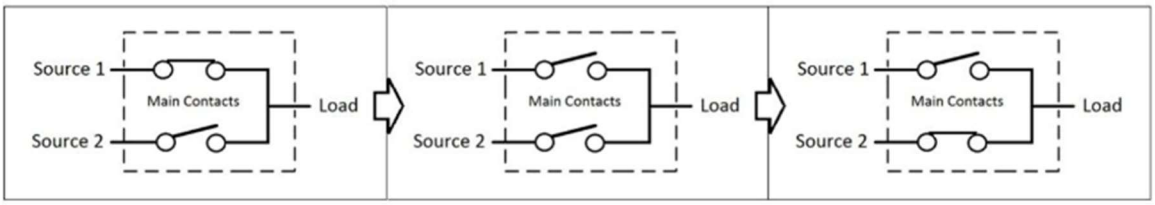
The key here is that an Automatic Transfer Switch has a "primary" contact. If the Grid and the Backup both have voltage, the ATS will *favour the primary connection*. As long as the Grid is connected on the Primary terminals of the ATS, the Grid will always be the default supply to the Backed-Up loads.

BREAK BEFORE MAKE

The other function of a good Automatic Transfer Switch or an "appropriate" changeover switch is that, unlike a "simple" Changeover switch, the transfer between the two supplies has an "off" position. This "off" position acts to break the contact first, preventing the possibility of connecting to both contacts via arcing.

The Clipsal example to the right shows a manual "Changeover" switch with a centre off position. We'll consider this as a manual Transfer Switch.

Automatic Transfer Switches should have the same "break before make" function. A break-before-make transfer switch breaks contact with one source of power before it makes contact with another. It prevents back-feeding from an emergency generator back into the utility line, for example. The "break" function may be extremely fast, such that it is not noticeable, so consult the datasheet for any switches that you are considering using.



RECOMMENDATION

Alpha recommends the installation of a Manual or Automatic Transfer switch when a Backup circuit is installed, particularly where any extended travel to site is involved.

These switches can cost as little as $60.00 (for a Manual one) and are well worth the additional cost for an end-user and may well save an installer a Friday-night callout too.

Note that you can expect teething issues with Manual Transfer Switches. At some stage, the homeowner will have the switch in the incorrect position. If they leave it in “Grid” mode, they’ll have no power on the next blackout. You know that this will happen, and you *know* they’ll call you…..