



Worry-Free on AC Switching **ATESS New DC Coupling Solution**





PART 1

System Overview

Overview

The perfect solution for **Large-scale Off-Grid** applications

ATESS DC coupling energy storage system aims to use the **Rectifier cabinet RTF** to replace the **Bypass cabinet** in ATESS' original AC coupling solution

Bypass



RTF

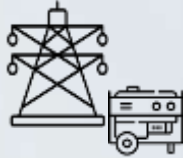




No switching
on AC side

5

Support grid and
generator access



1

Advantages

4



Less output
fluctuation

2

No risk of restarting
sensitive loads



3



ESS serves as buffer
power

▶ PCS/100/250/500/630/1000



Bi-directional Battery Inverter

- ▶ **Full capacity range**
100/250/500/630kW/1000kW single unit
- ▶ **Flexible configuration**
Can be used alone or combined to meet the peak load demand
- ▶ **Expandable**
Multiple in parallel to form MW level system
- ▶ **Touch screen**
Convenient for parameter setting and viewing

▶ PBD250



Solar Charge Controller

- ▶ **1000V DC – DC Converter**
Conversion unstable DC power to stable DC power
- ▶ **Modular design**
Multiple paralleling, easy maintenance
- ▶ **Up to 5 MPPTs**
Flexible PV array design, high yields
- ▶ **Scalable**
Configure MW level system by paralleling multiple units

▶ RTF300/600



ATESS Rectifier

- ▶ **Full capacity range**
300/600kW single unit
- ▶ **AC – DC Converter**
Only Conversion AC to DC, not Bi-directional.
- ▶ **Modular Design**
Each modular is 40kW, and maximum of 15 modules
- ▶ **Scalable**
Configure MW level system by paralleling multiple units

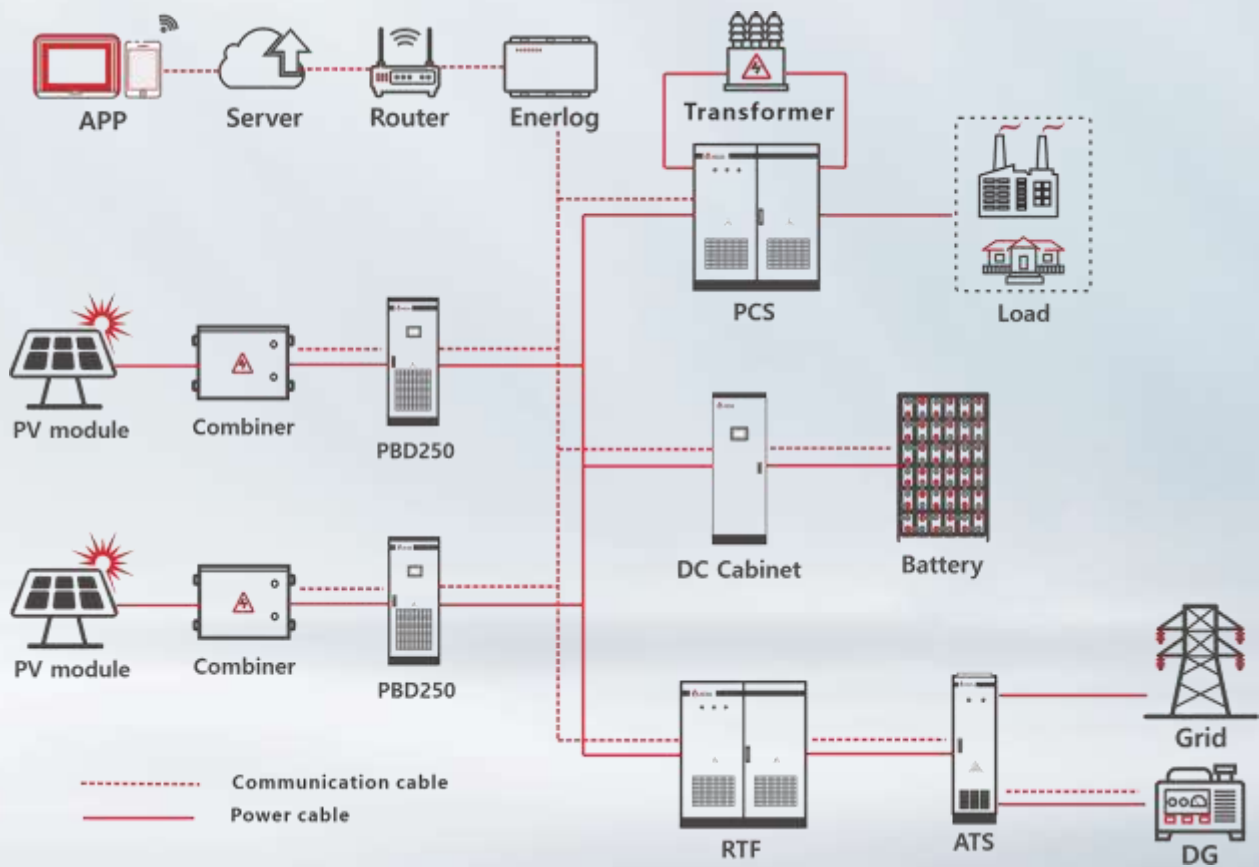
▶ **ATS630/1200**



Automatic Transfer Switch

- ▶ **DC Coupling system compatible**
- ▶ **Transfer automatically between Grid and DG**
- ▶ **Inbuilt Bypass switch**
- ▶ **Support remote control of DG**

Schematic Diagram



Recommendation: **RTF power should be higher than the peak load power**

- Knowledge of Peak load and Inductive load on site
- Rated power of: $ATS \geq RTF$, and $RTF \geq PCS$
- The max parallel number of PCS is **4 units** during any Off-Grid situation
- The parallel number of RTF and ATS are **unlimited** depends on the peak load on site

Note: It is recommended to contact ATESS product manager to provide the correct configuration plan, considering the diversity project requirements of large-scale industrial and commercial energy storage systems.

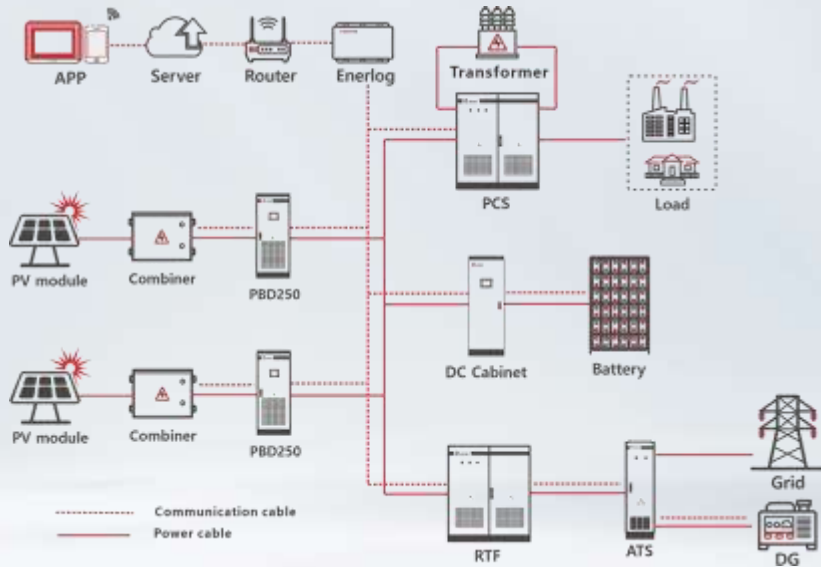


PART 2

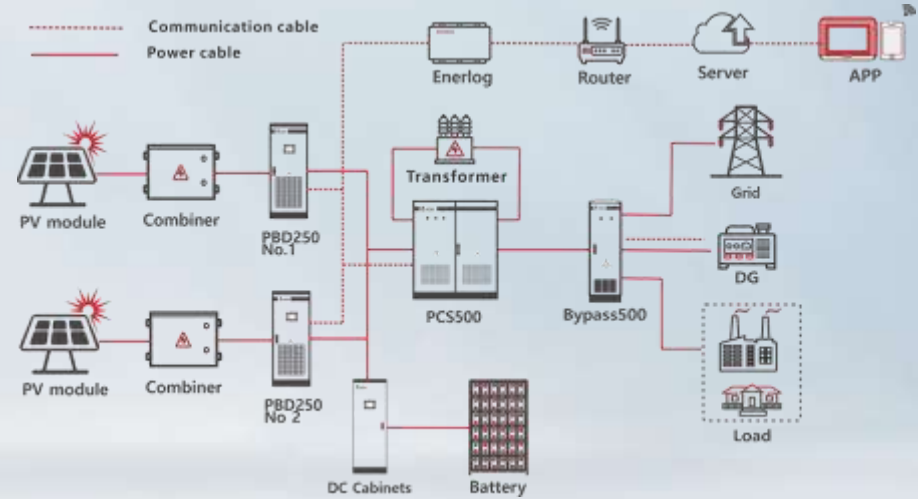
Comparison with AC Coupling Solution



New DC Coupling System



Original AC Coupling System



System Configuration Comparison

Configuration	NEW DC coupling	Original AC coupling
PCS	√	√
Battery	√	√
PBD	√	√
Bypass	×	√
RTF	√	×
ATS	√	×
PV Combiner Box	√	√
Enerlog	√	√



PART 3

Test Data Comparison

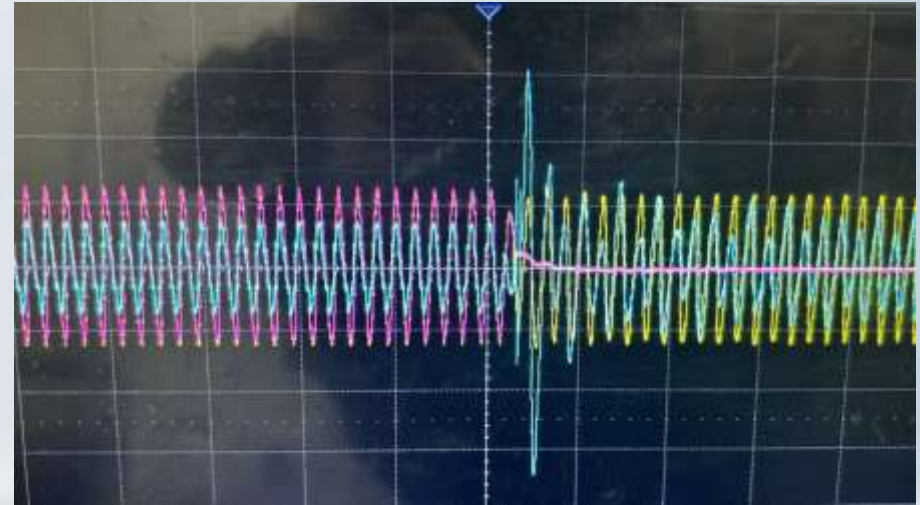
Switch from On-grid to Off-grid Mode -- Original AC Coupling Solution

Scenario:

- PCS500+Bypass500
- Inductive load 400KW

Issues:

- Voltage drop during the VF and PQ mode switching process
- Delay response time under the heavy load
- Sensitive loads restart causing inrush current
- Trigger PCS overcurrent protection fault state



Yellow: PCS output voltage

Red: Grid voltage

Blue: PCS output current

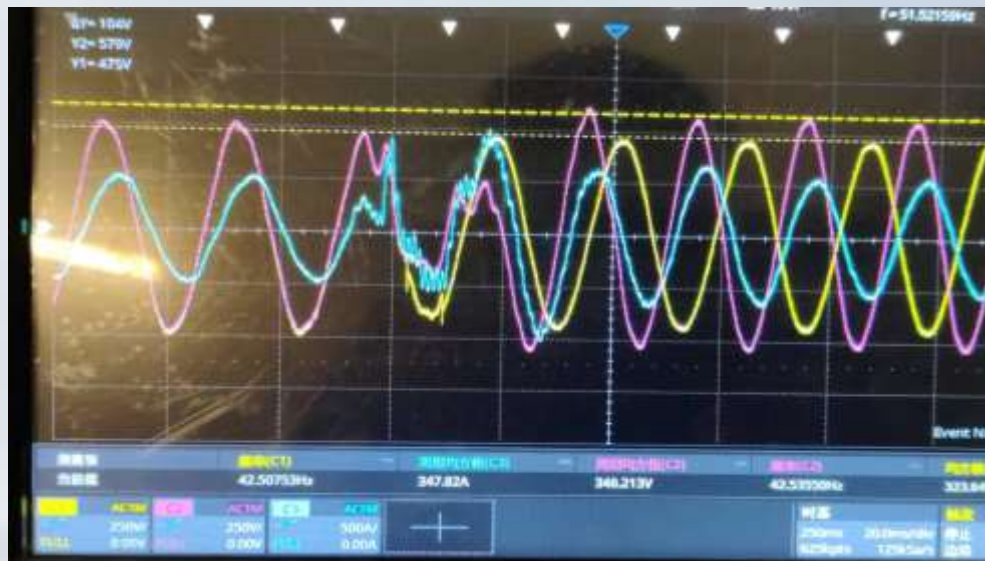
Switch from Off-grid to Generator Mode -- Original AC Coupling Solution

Scenario:

- PCS250+Bypass250
- Inductive load 150KW
- Generator power 250KW

Issues:

- Diesel generator mode triggers a voltage drop.
- PCS re-enters off-grid mode and then diesel generator voltage returns to normal.
- Weak generator performance



Red: Generator voltage

Yellow: PCS output voltage

Blue: Load current

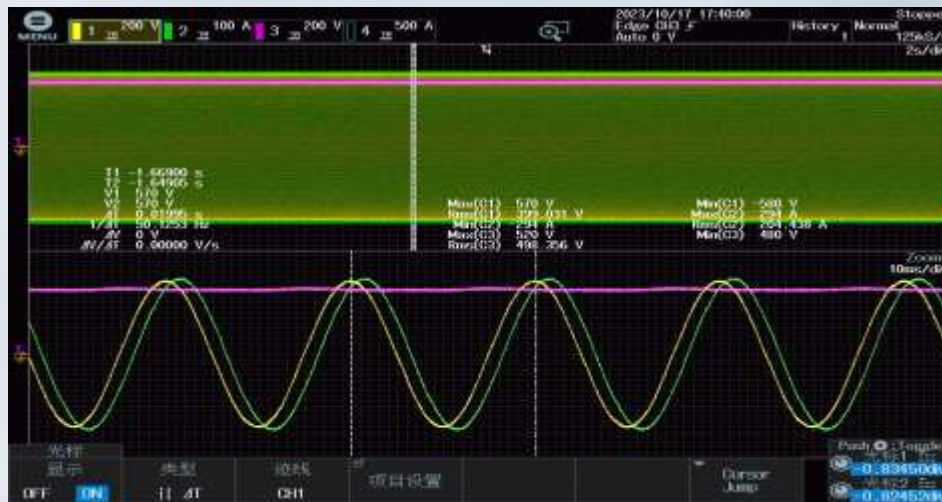
Switch from Grid online to Grid offline -- New DC Coupling Solution

Scenario:

- PCS500+RTF600
- Inductive load 400KW

Status:

- PCS always works in VF mode (Off-grid mode)
- When Grid fails, there is no switching action on the AC side of PCS
- Avoid on-site generator's weak performance



Yellow: PCS Output voltage

Green: PCS Output current

Load requirements – **New DC Coupling and Original AC Coupling**

Original AC Coupling Solution

- Inductive load power $\leq 50\%$ of PCS rated power
- VFD/VSD requirements:
 - Voltage: $-15\% \sim +10\%$
 - Frequency: $47\text{HZ} \sim 53\text{HZ}/57\text{HZ} \sim 63\text{HZ}$
 - Overcurrent protection: 1.5 times rated current for 60S
- Voltage drop time within 20ms

New DC Coupling Solution

- Inductive load power $\leq 70\%$ of PCS rated power.
- VFD/VSD requirements:
 - Voltage: $-15\% \sim +10\%$
 - Frequency: $47\text{HZ} \sim 53\text{HZ}/57\text{HZ} \sim 63\text{HZ}$
 - Overcurrent protection: 1.5 times rated current for 60S
- Voltage drop time within 20ms



PART 4

System Operation Strategy

Grid Online Mode

Back-up Mode

PV power + grid power \geq load power (Grid charging power can be set.)

Note: If the charging cut-off SOC is 95 % and the grid stops charging when it reaches 95%, the system needs to be able to judge whether the grid is charging or the PV is charging.

- If the grid is charging, the charging cut-off SOC will take effect. If the PV is charging, then it must be “PV power > load power” under this condition. For example, the load power is 20 kW, the PV power is 30 kW, and the battery charging power is 30 kW.
- When the real-time SOC does not reach the charging cut-off SOC set point, the grid and the PV charge the battery together until the real-time SOC reaches the charging cut-off SOC set point, the grid stops charging, and the excess PV continues to charge the battery to the charging cut-off SOC.

Standard Mode

- PV power > load power, the PV is loaded and charges the battery
- PV power < load power, PV and battery are loaded together until the battery is discharged to the discharge cut-off SOC, and then the grid takes over the load. In this mode, the grid does not charge the battery, but the SOC needs to be maintained at the discharge cut-off SOC.

Grid Online Mode

Time Schedule

- Level 1 Setting: Off-season and peak-season
- Level 2 Setting: Month period of off & peak-season
- Level 3 Setting: Weekdays, Saturdays, Sundays
- Level 4 Setting: On-peak period, off-peak period, mid-peak period

Note: The on-peak period corresponds to the standard mode, the off-peak period corresponds to the back-up mode, and the battery does not charge or discharge during the mid-peak period.

Grid Offline Mode

- PV power > load power, the PV is loaded and charges the battery.
- PV power < load power, PV and battery are loaded together until the battery discharges to the diesel generator to start the SOC, and then the generator supplies power to the load. The function of the generator to charge the battery can be set, and the charging power can be set, and the diesel generator supplies power to the battery until the diesel generator shuts down the SOC.

The conditions for starting and shutting down the diesel generator should take into account the SOC and should also include a one-key start and stop function that commands can be issued remotely through the server to start or shut down the generator.

Note: After the diesel generator is started, the mode displays as diesel generator online.



PART 5

Summary

Summary of the New DC Coupling System

▶ **Reduced AC Switching Operations**

- Each unit is in a single working condition.
- Significant decrease in PCS switching on the AC side

▶ **Elimination of AC Output Fluctuations**

- Avoid AC output fluctuations caused by switching.
- Greatly improves the stability of the load operation

▶ **PCS in Continuous Off-Grid Mode**

- Output voltage or frequency not affected by the fluctuations of the power grid or diesel generator
- Maintain voltage or frequency stability
- Ensure the power quality of load operation
- Improve the stability of the system