GALVANIC ISOLATION IN UPS

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I. INTRODUCTION

When an Uninterruptible Power Supply (UPS) is installed, it is expected that this will supply the critical loads with clean regulated power irrespective of whatever occurs on the upstream supply side. However, it is important to mention that only UPS with a fully galvanic isolation can handle distortions without compromise. This way eventual earth fault can be monitored and corrected before it comes to a malfunction in the system. In addition to this, galvanic isolation significantly reduces safety risks for maintenance personnel while working on systems.

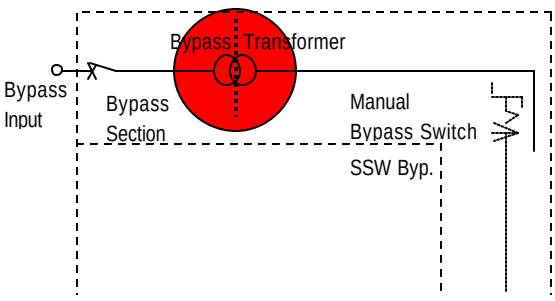
II. WHAT IS GALVANIC ISOLATION

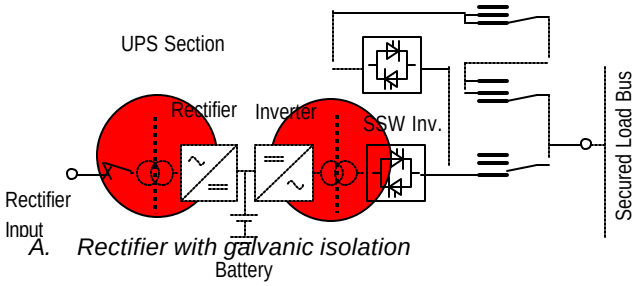
The galvanic isolation in a UPS is a complete physical separation between input and output and is achieved by means of transformers with physically different primary and secondary windings. These are often shielded from each other by an additional electrostatic plate to further reduce common mode-noise. With a fully galvanic isolation the output of the UPS can be considered as a derived source that can be grounded, or left floating depending on the application.

III. WHY GALVANIC ISOLATION

Only with a fully galvanic isolation between input (rectifier and bypass) and output, the highest level of protection against all kinds of distortions can be secured. Without, the neutral will pass straight through the UPS and can be a possible path for common mode distortions. Especially in an industrial environment the level of power distortions can be very high. Galvanic isolation is also needed to secure that the output in all operation modes can be grounded according to the requirements of most international and local standards. To achieve a fully galvanic isolation in the UPS system following function blocks need to have there own galvanic isolation: Rectifier, Inverter and Bypass. For details of each block see Fig.1

Fig. 1 "UPS with fully galvanic isolation between input and output"





A. Rectifier with galvanic isolation

Advantages:

- Higher immunity against distortions in input mains; transient voltage surge will be reduced and thus secure a cleaner DC-Bus, which minimizes the risk of a malfunction of the Inverter connected to the DC-Bus.
- Possibility to monitor and react on earth fault in the DC-Bus and battery bank (No trip of the battery bank by earth fault, fault can be monitored and it's possible to react before system will shut down).
- Reduction of harmonic current feed back to input mains.
- No DC feedback by major failure in the Rectifier.
- Higher safety while working on batteries for maintenance personnel.

Disadvantages:

- Higher cost
- Lower efficiency
- Possible impact on the dimension of the UPS

B. Inverter with galvanic isolation

Advantages:

- Output can be grounded, which is required by most standards. This may require a bypass transformer, depending on the design.
- No way to get DC on the output of the inverter by a fatal error in the inverter part. Systems without transformers rely on an electronic monitoring, which will switch off the Inverter if a critical fault occurs in the Inverter.
- The transformer can also be used to adapt the output voltage to the right level.
- For three-phase system; The inverter transformer reduces the 3rd harmonics current caused by switch mode load.

This will reduce the voltage distortion on the output compared to transformer less Inverters.

- The single-phase short-circuit current for a three-phase system with transformer will be ~1.7 times the short circuit current of an UPS without Inverter transformer, based on the same Inverter rating.

Disadvantages:

- Higher cost
- Lower efficiency
- Possible impact on the dimension of the UPS

C. Bypass with galvanic isolation

Advantages:

- Effective reduction of common mode noise as the input and output neutrals are not connected. Without a transformer the neutral is connected and thus forms a direct path for common mode fault.
- The neutral at the output can be grounded, regardless of upstream supply configuration, which is required according to most standards.
- The transformer can also be used for voltage adaptation if input and output voltages are different.
- Three phase to one phase transformer can be used for single-phase output to secure a certain current distribution to all three bypass input phases.
- The transformer can also be combined with a voltage-stabiliser.

Disadvantages:

1. Higher cost.
2. Lower efficiency.
3. Possible impact on the dimension of the UPS.

IV. CONCLUSION

In a typical industrial environment only a fully galvanic isolation from Rectifier input to DC-bus, DC-bus to Inverter/UPS output, and Bypass input to UPS output, can provide highest level of protection against all kind of power distortions.

V. VITAE

Gert Andersen received a bachelor degree in electronic science from the University of Odense in Denmark. Prior to his employment with GUTOR Electronic Mr. Gert Andersen worked as R&D Manager in the Laboratory of Energy Research University of Odense and during 1984 and 1988 in SILCON A/S, Kolding. He joined GUTOR in 1988 and currently is the Technology Director. Gert Andersen is a member of IEEE.