

# UNINTERRUPTIBLE POWER SUPPLY CONTROLLED BY DIGITAL SIGNAL PROCESSOR

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## INTRODUCTION

Only the reliability was required about ten years ago. Nowadays there are some the requirements on UPS like good power factor, small current distortion, capability work with diesel generator, advanced battery management, sinusoidal output voltage must be independent on the load character etc.

There are just three different remarkable conceptions used at all. But none of them is better than the others – each conception has its advantages and disadvantages. Our development intention is to design UPS that will have not any disadvantages listed below.

## BODY OF PAPER

The present state of UPSs (3 phase UPS above 20 kVA) on the market:

- 1) Double-conversion UPS – The increasing booster is connected after the input rectifier. The battery booster and the main inverter are supplied from the increasing booster (the voltage level is +/-396V). The battery set (from 2x10 up to 2x25 batteries - 12V each) is connected between the input rectifier and the booster. Its voltage is always smaller than the average value of rectified voltage.
  - + Input is separated from output, input and output frequency can be different
  - + Without the transformer
  - Non-controlled rectifier on input – big current distortion and bad power factor
  - Triple- conversion – input rectifier, increasing booster, inverter → low efficiency
- 2) Double-conversion UPS with transformer – The accumulators and the main inverter are supplied from the input controlled thyristor rectifier which output voltage is increased and separated by transformer.
  - + Input rectifier charges the accumulators
  - + Output is galvanically separated from input
  - Six pulse controlled rectifier → big current distortion and bad power factor. It depends on fire angle.
  - Include the fully power sizing transformer – big, heavy, expensive
- 3) Delta-conversion (Single-conversion) UPS – The transformer with ratio 1:5 is connected between input and output. The transformer output is connected via the second inverter (about 20% of nominal power) to the battery pack (2x32 batteries - 12V each). The second inverter improves the voltage level and compensate input power factor. The main inverter works only as inverter in case of failure of mains.
  - + High efficiency - specially when the input and output voltage is equal
  - + High efficiency by working from accumulators – only one conversion
  - + Input power factor is nearly to 1, the current is sinusoidal

- + The UPS power is in kW, not v kVA (usually is  $P \text{ (kW)} = 0,8 \times S \text{ (kVA)}$ )
- Output and input Voltage has the same frequency
- Output is not separated from input by DC link
- Include transformer (about 20% of nominal power)

The present state of UPSs control:

The control of the power part is analog control system and dominance digital control system works for communication between UPS and PC, for measurement of input values, for accumulator monitoring etc. The switching frequency of inverters is about 5 kHz. The output current is too much deformed and has bad power factor.

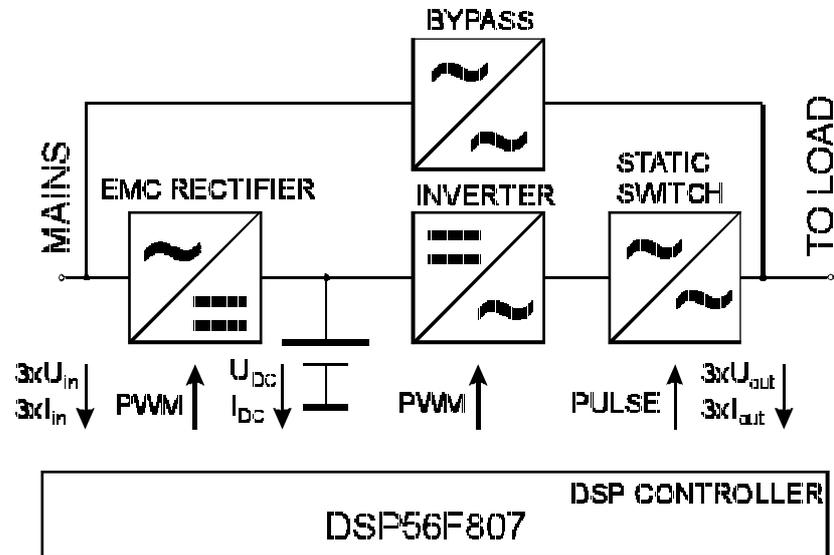


Fig. 1 block scheme of new UPS

The next generation of UPSs:

The analog controllers are obsolete technology in this time. Because of this we try to develop the new UPS with fully digital control system with following requirement.

- The switching frequency is above acoustic range
- Input current is always sinusoidal. Input power factor is nearly to 1 and is independent on the input frequency, voltage and output current
- The input current increasing on the ramp, cooperation with generator, input and output frequency can be different
- The current is limited on change of load, possibility of AM starts, possibility of recuperation
- The UPS can start from mains or batteries, auto start on the end of mains fault, battery sharing, battery test – discharging to the mains, power dividing between battery and mains
- The possibility of Economy mod (bypass)
- Parallel cooperation peer to peer, integrated SNMP adapter, connect and disconnect UPS on working state
- The auto tests of the state etc.

## CONCLUSION

Original conception of power part and DSP control enabled to reach high quality parameters as low deformation of input current, stable output voltage with dynamic changes of load. Such behaviour is not possible with an analogue control and standard connection of power part.

## REFERENCES

User's manuals - Newave, Apc, Saft