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Integrated Linear Transformer-Based Diode Bridge Rectifier for Improved Power Quality in Electric Vehicle Charging Stations

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INTRODUCTION & AIM

- The rapid development of charging infrastructure demands high-quality grid-side rectifiers capable of ensuring high power quality, lower harmonics, and higher grid compatibility.
- The diode bridge rectifiers (DBR) and , DBR+DC-DC Converter used traditionally, have low power factor, large THD, and large ripple, and are incompatible with IEEE 519-compliant EV charging stations.
- The proposed LT+DBR (Linear Transformer Assisted DBR) system improves the input current shaping, comparatively lower the harmonic injection, and offer an efficient and low distortion AC-DC interface to EV chargers.
- This study aims to develop LT+DBR based charging infrastructure to meet the IEEE power quality requirements.

METHOD

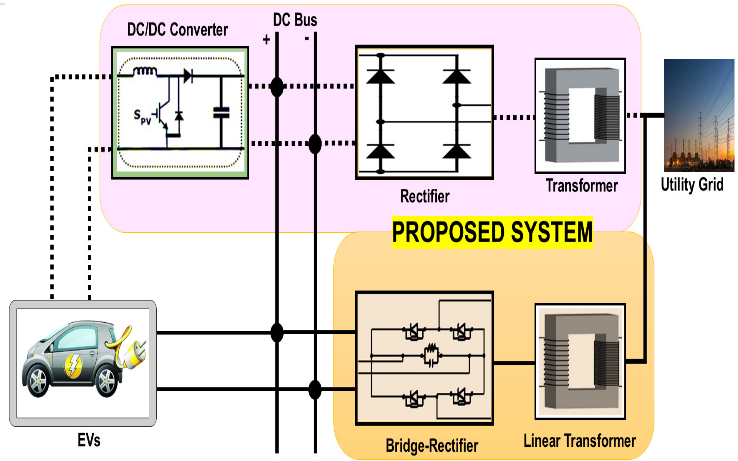

Fig. 1. Integrated LT-DBR Based EV Charging Station

RESULTS & DISCUSSION

- Figure 2 shows the output voltage characteristics of a proposed LT+DBR system, achieving improved voltage regulation with a small ripple of 0.7% and a stable output voltage (60.7 V).
- The frequency response has the lowest transient overshoot and quick settling (0.12 sec), and the waveform most similar to the nominal 50 Hz of all topologies as shown in Fig. 3.
- Figure 4 shows the power factor characteristics of proposed LT+DBR system, achieves nearly unity power factor of 0.98, and Figure 5 depicts the highest efficiency of 96.3%.
- Figure 6 shows the harmonic analysis of proposed LT+DBR delivers an IEEE compliant THD of 4.32%, which indicating its better power-quality performance in the modern grid-connected EV charging systems.

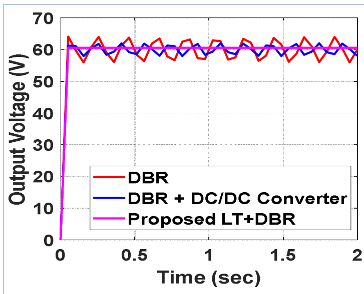

Fig. 2. Output voltage

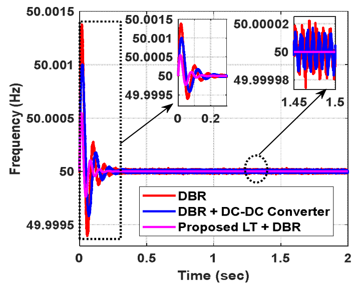

Fig. 3. Frequency

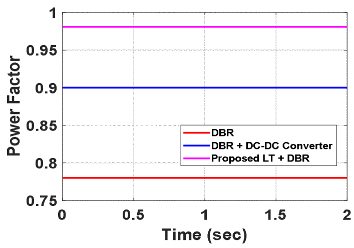

Fig. 4. Power factor

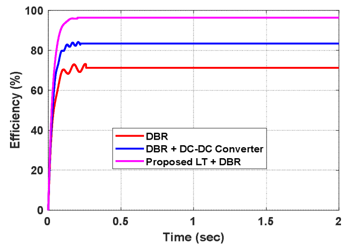

Fig. 5. Efficiency

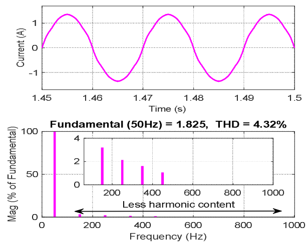

Fig. 6. Current THD

CONCLUSION AND FUTURE SCOPE

- The EV charging station with LT+DBR provides significant enhancement of PF, THD, voltage regulation and efficiency, hence, recommended for grid-integrated charging stations.
- The integration of renewable sources, optimization of higher power levels to allow scalable deployment in smart-grid and fast-charging applications in the future work.

KEY REFERENCES

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