# Energy Efficient Power Supply with Power Regenerating Capability for Railway Applications

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Proposed research Work:

Boost converters are employed at the output of rectifiers the multi pulse converter are also called Active Front End (AFE). It operates in four quadrants along with IGBT inverter and supplies regenerative power. (AFE), can be classified as Voltage Source Rectifiers (VSR) and Current Source Rectifiers (CSR). The AC current is in phase with voltage the same as pure resistive load. AFE does not exchange reactive power with the line, but exclusively active power. PWM regenerative rectifiers are a highly developed and mature technology with a wide industrial acceptance.

## The PWM control converts an analog input level into a variable duty cycle switch drive signal. If high output is commanded, the switch is held on most of the period. The switch is usually both on and off once during each cycle of the switching frequency, but many designs is capable of holding a 100% on duty cycle. In this case, losses are simply a factor of the on resistance of the switch plus the inductor resistance. As less output is commanded, the duty cycle or percent of on time is reduced. Note that losses now include heat generated in the fly back diode. At most practical supply voltages this diode loss is still small because the diode conducts only a portion of the time and voltage drop is a small fraction of the supply voltage. The job of the inductor is both storing energy during the off portion of the cycle and of filtering. Inductors make their living by demanding continuous current flow; they become the energy source during the off time. In this manner the load sees very little of the switching frequency, but responds to frequencies significantly below the switching frequency. When the load itself appears inductive, it is often capable of performing the filtering itself. In order to simplify the analysis, the following Input voltages are considered equal, sinusoidal and displaced by 120'; the input stages (Boost PFP) generate input currents that are also sinusoidal control scheme that allows the operation of a three level active front-end converter as a rectifier

**Background:**

The Power Supply industry, especially in Asian emerging economies, is undergoing phenomenal growth, both in terms of voice and data. In railway, power rectifiers are an integral part of telecom rectifier systems. They are also used in battery chargers, DC drives, DC power systems, and other power system device power systems secure services in case of power interruptions or fluctuations. The essential parts of the system are rectifiers, batteries and a power system controller. The rectifier converts alternating current (AC) to direct current (DC) and provides the power necessary to charge the batteries. The power system controller monitors and controls the entire system and site power infrastructure, maximizes battery life, supports energy saving and informs the operator of maintenance needs

## Objectives:

To design power supply for railway applications and to develop a regenerative power supply which is having very low harmonic distortion, No complex circuit, low probability of faults fewer components, reduced reactive power, lower power costs. The main characteristics of the proposed system are its Regenerative feedback capability, low harmonics, extremely low delay time, fewer components, No commutation faults when the power fails in regenerative operation (4-quadrant operation) and power factor between 1.0 & 0.8. The aim of my research work is to improve performance rail way power supply with respect to efficiency and power factor.

**Discussion and Conclusion:**

This research proposal gives detailed theoretical and practical study of a three-phase multi-pulse – multi level power supply rail way. It is proposed a simple control Strategy to guarantee balanced input currents in three-phase rectifier that is composed of single-phase modules.

**REFERENCES**

[1] B. Singh, B. N. Singh, A. Chandra, K. Al-Haddad, A. Pandey, and D.P. Kothari, “A review of three-phase improved power quality ac–dcconverters,” IEEE Trans. Ind. Electron., vol. 51, no. 3, pp. 641–660,Jun. 2004.

[2] B. M. Saied and H. I. Zynal, “Minimizing current distortion of a three phase bridge rectifier based on line injection technique,” IEEE Trans. Power Electron., vol. 21, no. 6, pp. 1754–1761, Nov. 2006.

[3] M. R. Ramteke, H. M. Suryawanshi, and K. L. Thakre, “Single-phase resonant converter in three-phase system in modular approach,” EPE J., vol. 16, no. 4, pp. 5–13, Dec. 2006.

[4] A. K. S. Bhat and R. L. Zheng, “Analysis and design of a three-phase LCC-type resonant converter,” IEEE Trans. Aerospace Electron. Syst.,vol. 34, no. 1, pp. 508–518, Apr. 1998.

[5] S. S. Tanavade, H. M. Suryawanshi, and K. L. Thakre, “Novel single-phase ac-to-dc convertor using three-phase modified series-parallel resonant converter,” IEE Proc. Elect. Power Appl., vol. 152, pp.1027–1035, Jul. 2005.

[6] R. L. Steigerwald, “A comparison of half bridge resonant converter topologies,” IEEE Trans. Power Electron., vol. 3, no. 2, pp. 174–182,Apr. 1988.

[7] T.-F. Wu and S.-A. Liang, “A systematic approach to developing single-stage soft switching PWM converters,” IEEE Trans. PowerElectron., vol. 16, no. 5, pp. 581–593, Sep.. 2001.

[8] R. Watson, F. C. Lee, and G. C. Hua, “Utilization of an active clamp circuit to achieve soft switching in flyback converters,” IEEE Trans.Power Electron., vol. 11, no. 1, pp. 162–169, Jan. 1996.

[9] J. A. Cobos, O. Garcia, J. Uceda, J. Sebastian, and E. Cruz, “Comparison of high efficiency low output voltage forward topologies,” in Proc.IEEE PESC, 1994, pp. 887–894.

[10] M. M. Jovanovic, “A technique for reducing rectifier reverse recovery related losses in high power boost converter,” IEEE Trans. Power Electron.,vol. 13, no. 5, pp. 932–941, Sep. 1998.

[11] R. Ayyanar, R. Giri, and N. Mohan, “Active input voltage and load current sharing in input-series and output parallel connected modular dc-dc converter using dynamic input-voltage reference scheme,” IEEE Trans. Power Electron., vol. 19, no. 6, pp. 1462–1473, Nov. 2004.

[12] C. S. Moo, H. L. Cheng, and P. H. Lin, “Parallel operation of modular power factor correction circuits,” IEEE Trans. Power Electron., vol. 17, no. 3, pp. 398–404, May 2002.

[13] M. L. Heldwein, A. Ferrari de Souza, and I. Barbi, “A simple control strategy applied to three-phase rectifier units for telecommunication applications using single-phase rectifier modules,” in Proc. IEEE PESC’99, pp. 795–800.

[14] G. Spiazzi and F. C. Lee, “Implementation of single-phase boost power-factor correction circuits in three-phase applications,” IEEE Trans. Ind. Electron., vol. 44, no. 3, pp. 365–371, Jun. 1997.

[15] M. A. Chaudhari and H. M. Suryawanshi, “High power factor operation of three-phase ac-to-dc resonant converter,” IEE Proc. Elect. Power Appl., vol. 153, pp. 873–882, Nov./Dec. 2006.

[16] H. Bodur and A. F. Bakan, “A new ZVT-PWM dc-dc converter,” IEEE Trans. Power Electron., vol. 17, no. 1, pp. 40–47, Jan. 2002.

[17] M. M. Jovanovic and Y. Jang, “State-of-the-art, single-phase, active power-factor correction techniques for high-power applications-an overview,” IEEE Trans. Ind. Electron., vol. 52, no. 3, pp. 701–708,Jun. 2005.