

# Optimization of Current Total Harmonic Distortion in Series-Connected Rectifiers

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**Abstract.** An innovative method for reducing current total harmonic distortion on the AC side of twelve-pulse series connected AC/DC rectifiers is simulated in this paper. The principle of the method is to modify the current waveforms on the DC side of the converter by using self-commutated switches. An averaging inductor is added to the series connected converters and thus simplifies the pulse multiplication significantly. This method can make a 12-pulse double bridge converter to operate at 24, 36 and 48 pulses. A reinjection transformer is also used in series-connected converters to reinject a current to the main rectifier. Minimum value for the total harmonic distortion of AC current can be achieved by selecting an appropriate value for turn ratio of reinjection transformer. Genetic Algorithm (GA) has been used to calculate the optimal value for turn ratio of reinjection transformer. The total harmonic distortion of AC current has been calculated for different values of the turn ratio of reinjection transformer, and the minimum value of THD is obtained at turn ratio of reinjection transformer calculated by GA for 24, 36 and 48-pulse operation modes.

**Index Terms.** HVDC Systems, Reinjection Transformer, Harmonic Optimization, Genetic Algorithm (GA) and 36-Pulse Series-Connected Rectifiers.

## I. SIMULATION RESULTS

Simulations were carried out by the Simulink/Matlab. The configuration for a 36-pulse double bridge converter is shown in Fig. 1.

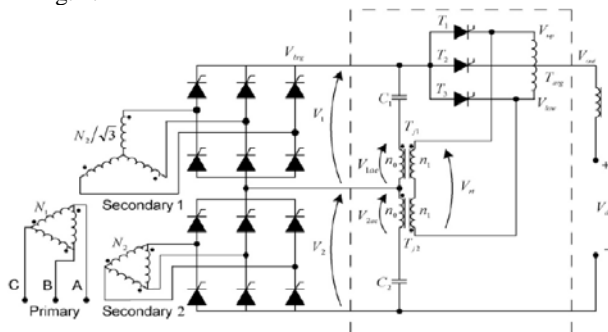


Fig. 1 Circuit configuration for 36-pulse series converters

The AC line current in series-connected rectifiers without reinjection is shown in Fig. 2. The total harmonic distortion (THD) of AC line current is 15.22%. The AC line current in 36-pulse series-connected rectifiers with reinjection is shown in Fig. 3. By selecting different values for the turn ratio of the reinjection transformer ( $k$ ) and after simulation for each value of ( $k$ ), the Total Harmonic Distortion (THD) of AC line current versus  $k$  is calculated which is shown in Fig. 4. Results show that the minimum Total Harmonic Distortion (THD) is 5.09% which happen at  $k=1.30756$  which is as same as the value obtained by GA. (36-pulse)

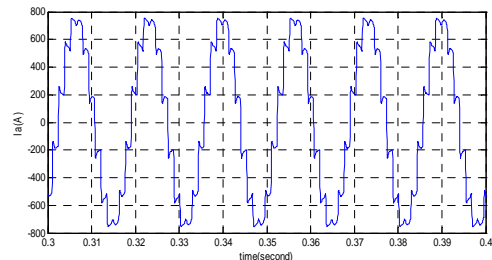


Fig. 2 AC line current without reinjection,  $\alpha = 15^\circ$

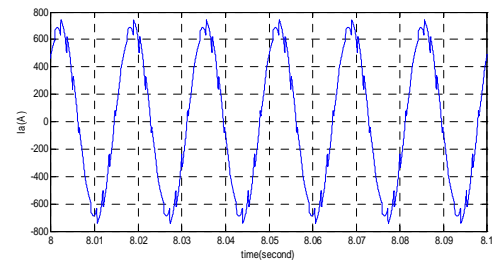


Fig. 3 AC line current with reinjection,  $\alpha = 15^\circ$  (36-pulse)

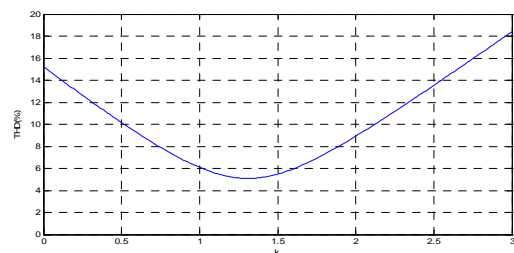


Fig. 4 THD versus  $k$  (36-pulse)