

SIMULATION AND IMPLEMENTATION OF GATE DRIVER FOR MEDIUM VOLTAGE THYRISTOR IN APPLICATION OF INDUCTION MOTOR SOFT STARTER

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Introduction:

AC voltage controllers are used as soft starters in induction motors for starting and to adjust its speed. This paper presents a novel topology of gate driver for ac voltage controller to generate the firing pulses for appropriate thyristors. In this paper simulation results and experimental results have been presented for the proposed method.

Block Diagram of Gate Driver Circuit:

Fig. 1(a) illustrates a typical thyristor gate current waveform for turn-on. Fig.1 (b) shows block diagram of gate driver circuit for medium voltage thyristor. Each channel of a Gate Driver board is made up of four sections: 1) fiber optic receiver and gating logic, 2) driver stage and pulse forming network, 3) isolation transformer, and 4) Output rectifier and terminating resistor. Fig. 1 is essentially a push-pull switch mode converter with virtually no output capacitance and a transformer capable of handling the first half-cycle switching event without saturation. The output's rectified square wave (dc) has an amplitude profile that is enhanced with a primary side pulse shaper to provide a strong leading edge. The fiber optic receiver (Rx) converts the gate command light signal into the logic signal that is characterized by a square wave pulse train. The gating logic converts the signal into an even number of high side and low-side pulses suitable for a totem pole drive stage. The transformer is generally a high permeability ferrite core of low turn count (1:1 ratio) to reduce parasitic inductance and interwinding capacitance. The bipolar square wave signal derived from the secondary is full-wave rectified via fast recovery rectifiers into a dc pulse. Terminating impedance can be used to enhance the noise immunity and help protect against transient gate reversal.

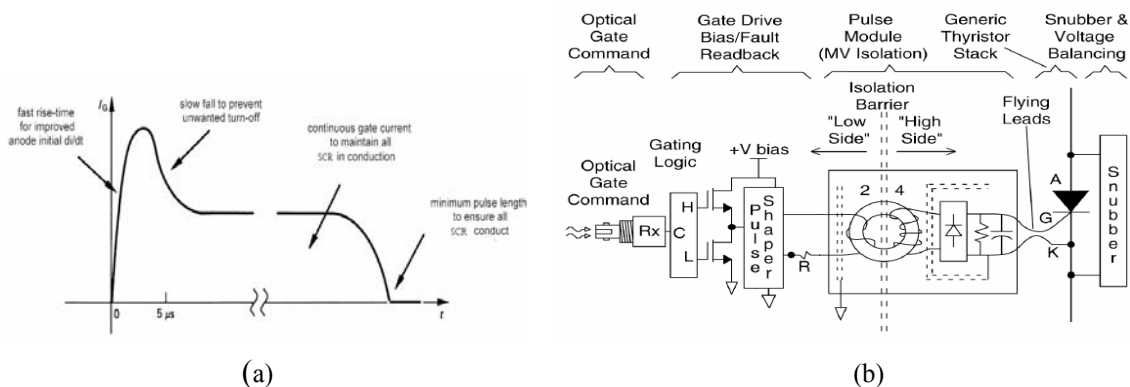


Fig. 1 Generalized current profile and block diagram of gate driver circuit for thyristors

Simulation and Experimental Results of the Proposed Topology of Gate driver in soft starter application:

Fig 2 (a) shows the basic circuit diagram to simulate the soft starter of induction motor in PSIM 6.0 software tool.

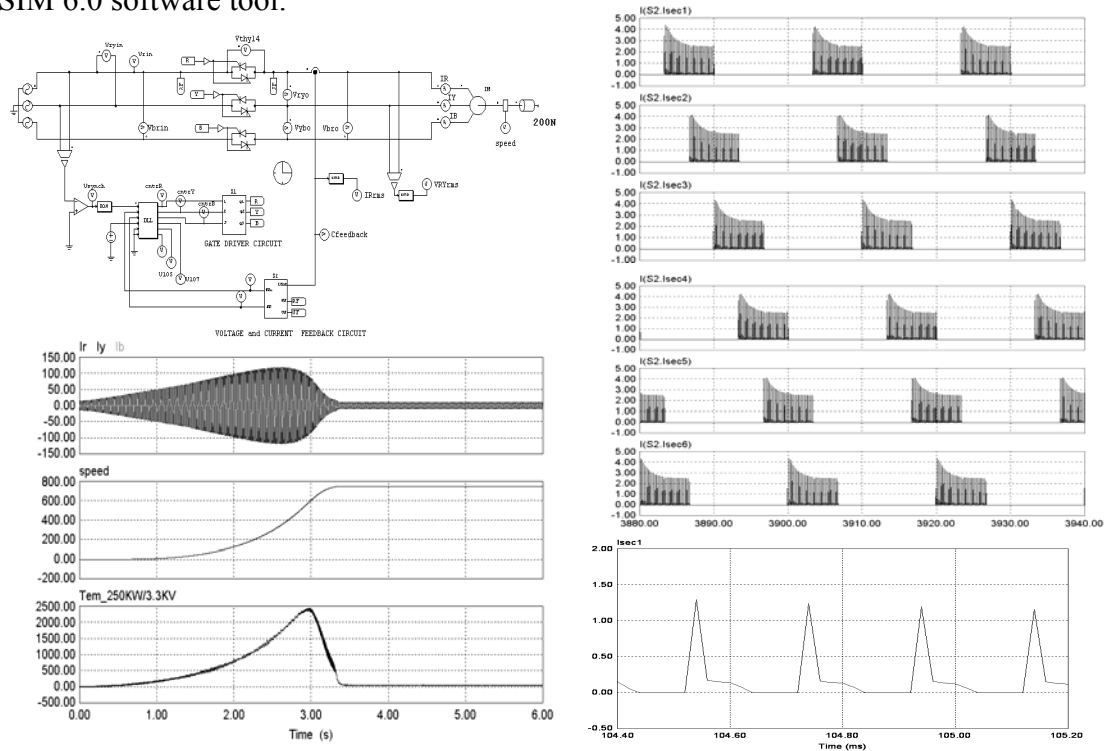


Fig. 2 Simulation diagram of soft starter, simulation results of gate pulses for all six thyristors, starting current, speed and torque of 3300V, 250KW induction motor and enlarge view of gate pulse. In this scheme only two scrs are on at a time. In simulation and experimental results the gate pulses is 4.5 V magnitude and width of 35 μ s, which is sufficient for medium voltage thyristor to trigger.

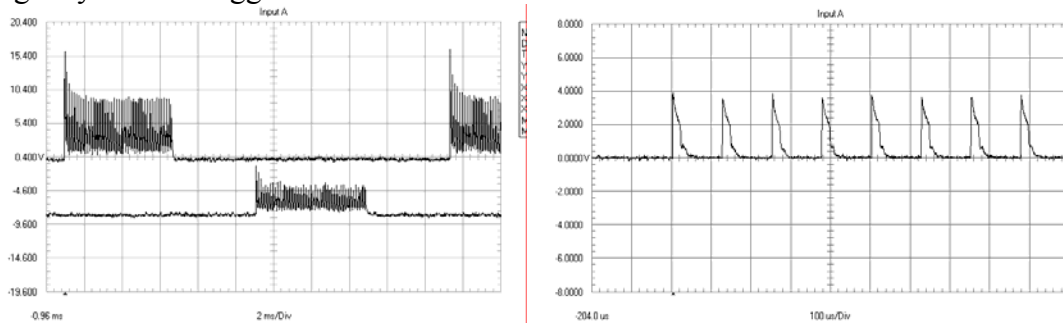


Fig. 3 Experimental results: gate pulses for R phase and enlarge view of gate pulse

Conclusion:

A voltage-controlled, thyristorised medium voltage induction motor soft starter is carried out by the use of some simple control strategies implementable on a digital signal processor. From the simulation of proposed strategies, a good acceleration profile can be tailored by smooth, pulsation-free torques over the entire starting period and gate driver results of simulated and experimented are approximately same so we can use this gate driver circuit to generate gate pulses for thyristor in soft starter application.