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An Inexpensive Method for Improving the Stability of Grid Connected Inverters Operating in Continuous Mode

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ABSTRACT

An inexpensive method for control of inverters, pushing electrical energy from renewable sources into the grid, is presented. This method consists in a subsidiary fast feedback from the output of the current sensor to the control input of the pulse forming unit. This feedback improves the stability at operating mode with continuous primary current.

Keywords: inverter, current mode, continuous mode.

INTRODUCTION

At continuous mode the grid connected inverter has a behavior of an aperiodic network with a great time constant, which is near to an integrating network. In combination with the output inductance and a low frequency filter in the basic feedback, a precondition for oscillations of the injected current occurs. The offered method is an attempt to eliminate this precondition.

THE CORE OF THE METHOD

Inverters operate with PWM network. The current is controlled via the pulse width. A fast, not filtered feedback from the current sensor to the input of the pulse width control circuit will set the initial value of this current and will operate like a current mode controlled inverter, because the initial value of the secondary current is near to the end value of the primary current. The advantages of this mode are treated in [1].The block circuit is presented in Fig. 1.

The output current $I_{OUT,}$ injected in the grid, is controlled via a set value I_{SET} through a PID network 1, which changes the pulse width (duty cycle) of the PWM network 2. At continuous mode, the inverter 3 has a behavior, near to an integrator. The current sensor 4 puts the actual value through a low-pass filter 5 into the input of the PID network.

The new fast feedback uses the same output of the current sensor 4 and mixes its voltage with the output signal of the network 1. So this signal operates approximately as a "set" signal for the initial value of I_{OUT}.

In Fig. 2 the circuit for modeling of the presented method on the program SIMETRIX / SIMPLIS is presented [1]. The circuit is designed

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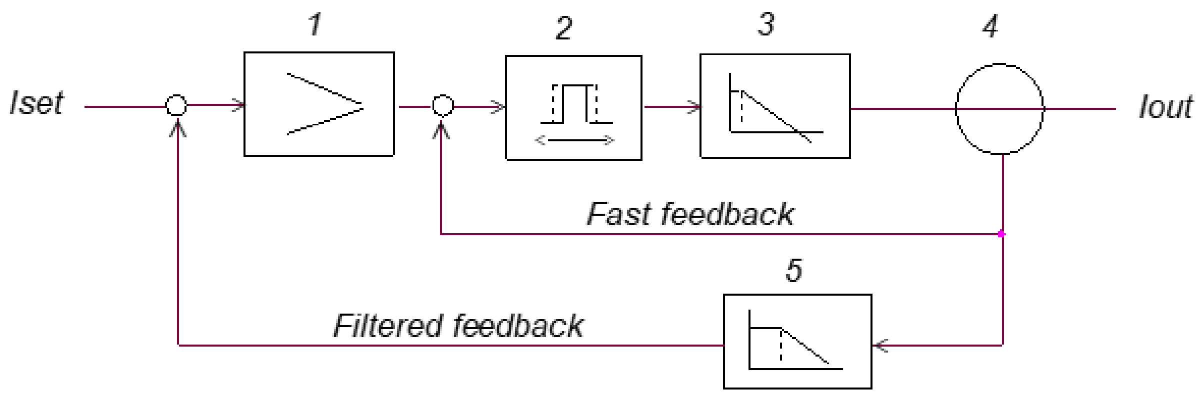


Fig. 1. Block circuit of the proposed method.

for the inverter, presented in [2, 3]. The traditional feedback is from the current sensor through the filter R12, C4, C10, R15, R7 to the input of the amplifier X2 - type TL072. The fast feedback is from the same sensor to the second amplifier X1, which controls the pulse width via the comparators U1 and U5. They compare the output voltage of X1with the triangle voltages, generated from V10.

The grid voltage V2 is set as a sinusoidal with a RMS value 240V, 50 Hz and amplitude value 340

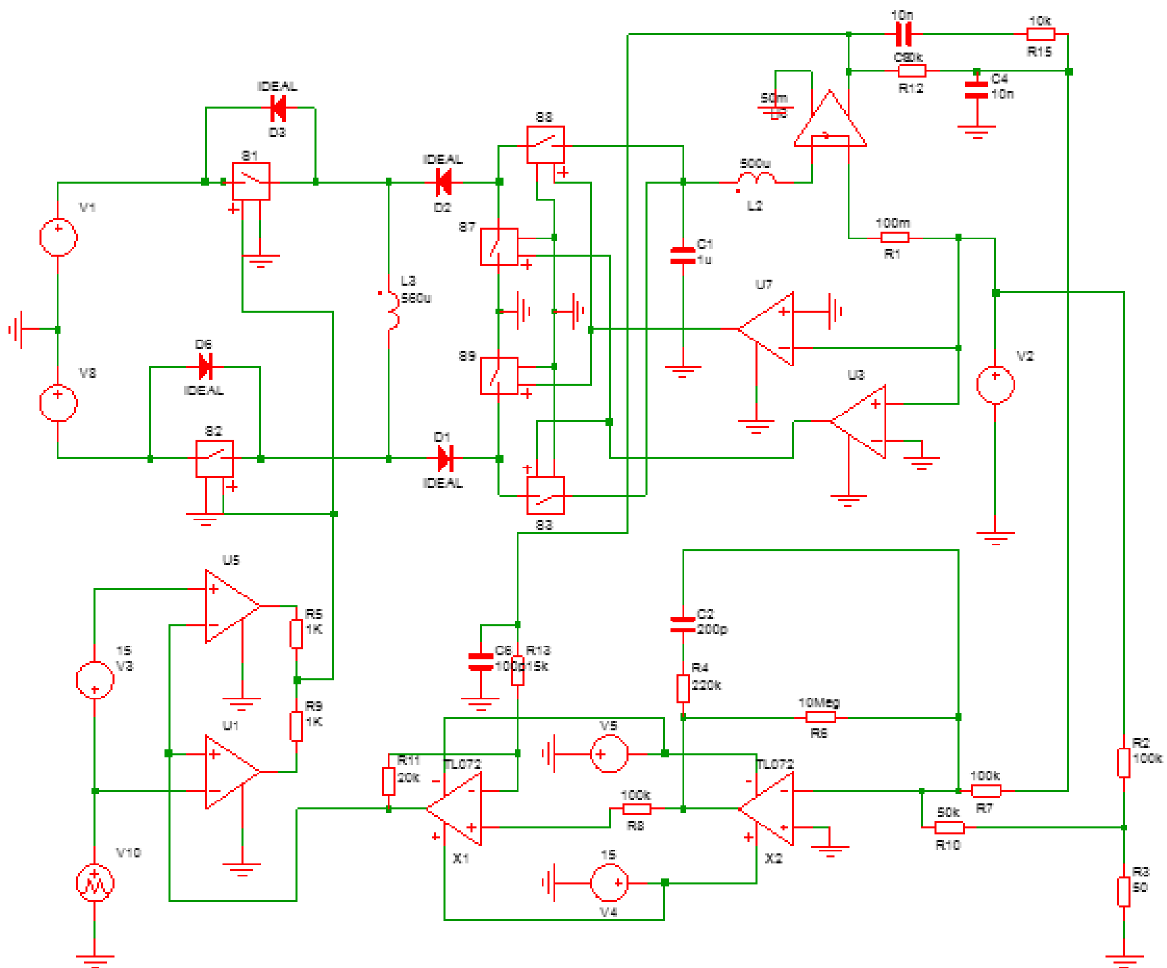
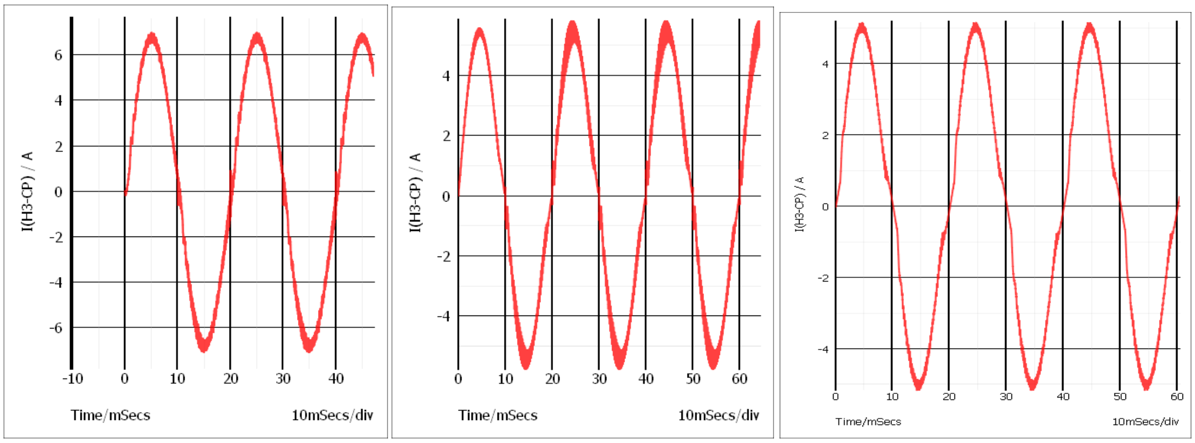


Fig. 2. Modeling circuit of the proposed method.



a b c

Fig. 3. Output current for input voltage: a) 200V; b) 150V; c) 100V.

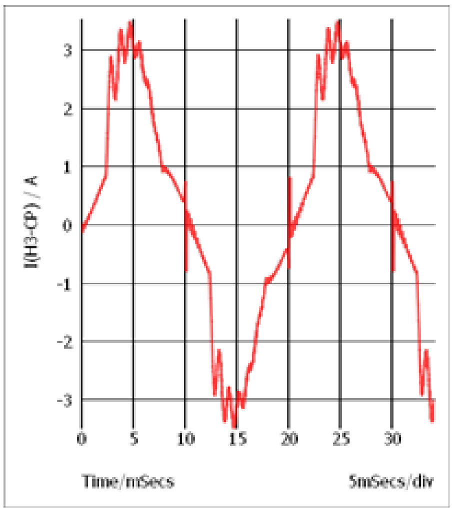


Fig. 4. Output current with disconnected fast feedback.

V, which is the standard value in most countries. The circuit was mould for different input voltages. The results are presented on Fig. 3. With a precise selection of the elements, better results can be achieved, but this is not the aim of this paper.

For comparison, only the fast feedback was disconnected. The form of the got output current, injected in the grid, shown in Fig. 4, corroborates the effect of the proposed new feedback.

CONCLUSIONS

The last result with disconnected fast feedback in comparison with the results in Fig. 3 (a, b, c) demonstrates the effect of the proposed method. The method is inexpensive, because no current sensor for the primary current is necessary. The control circuit is also very simple. Another advantage of this method is the absence of problems at duty cycle greater than 0,5, which is typical for most inverters, operating in current mode.

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