

CONTROL ALGORITHM OF MINIMUM MEASURES FOR ACTIVE POWER FILTERS AND SYNCHRONOUS RECTIFIERS

Rico A., Milanes M^a L., Romero E., Barrero F.

Department of Electronic and Electromechanical Engineering

School of Industrial Engineering

University of Extremadura

Avda. de Elvas, s/n. 06071. Badajoz (Spain)

Phone: +34 924 289600, fax: +34 924 289601

E-mail: aricmar@tauro.unex.es, milanes@unex.es, eromero@unex.es, fbarrero@unex.es

ABSTRACT

This paper presents a system that controls a power stage which may operate as a Synchronous Rectifier, as an Active Filter or as a Hybrid System. The implemented control strategy guarantees the minimum current measurements: only supply currents.

INTRODUCTION

Non-linear loads connected to the electric power system, leads to distortions in the source current. In this paper, a three-phase inverter, named from now on Conditioner System will be used to correct these distortions.

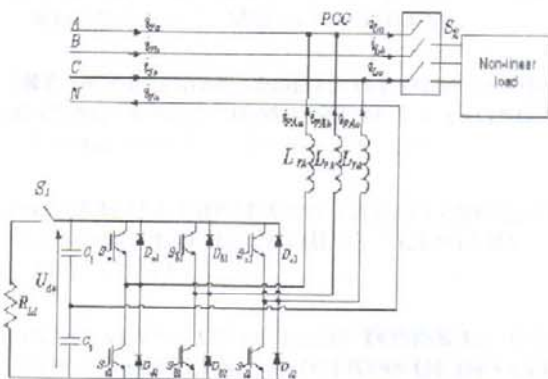


Fig.1. Conditioner System with non-linear load and three-phases controlled rectifier.

The aim of this paper is studying the use of this Conditioner System which may be used in three operation modes:

- As a Synchronous Rectifier [2].
- As an Active Filter. [3,4]

- As a Hybrid System, therefore Active Filter and Synchronous Rectifier at the same time.

The electronic system chosen to get that objective is the one shown in fig. 1. It has been placed two switches S_1 and S_2 , so it may be chosen the operation modes before described.

POWER STAGE. OPERATION MODES.

As written before, the system will have three operation modes we are describing:

- Synchronous rectifiers:

In this case the switch S_2 will be opened (OFF) and the switch S_1 will be closed (ON). Therefore a non-linear load RL_1 will be connected.

The working system as a synchronous rectifier it will be get by this operation mode, so the demanded current will be sinusoidal behaving as a linear load. The voltage source allows to regulate the dc bus voltage and supply more power than a regular rectifier.

- Inverter or Active Filter:

In this case the switch S_1 will be opened (OFF) and the switch S_2 will be closed (ON). Therefore a non-linear load RL_2 will be connected.

The working system as an inverter or Active Filter get by this operation mode allows to create currents able to correct both the harmonics and unbalance in the load current. Acting this way, the form current source has a high-quality wave.

- Hybrid System:

In this case the switch S_2 will be closed (ON) and S_1 will be closed (ON). Therefore, the hybrid System will work as an Active Filter or Inverter and as a Synchronous Rectifier providing all the advantages before described. The DC bus voltage must be an adequate value for both functions.

CONTROL STRATEGIES

The selected control strategy will be the Voltage Synchronisation also known as UPF (Unity power Factor) [1,4]. Its objective is to get the source to supply the constant active power demanded by the load, so it is get a unity power factor in the system. The reference currents are obtained by multiplying the sources voltages, U_{pcc} , by a K factor what is calculated from the existing tracking error between the measured dc bus voltage $U_{dc, meas}$ and a reference value $U_{dc, ref}$ using an proportional integrator (PI) with transference function $K_c(s)$.

$$i_{s, ref}(s) = K(s) U_{pcc} = (U_{dc, ref} - U_{dc, meas}) \cdot K_c(s) \cdot U_{pcc}$$

The algorithm block scheme is shown in fig 2.

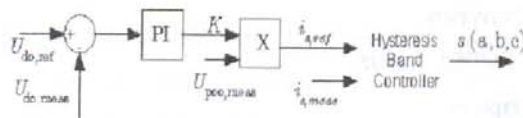


Fig.2. Control Block Scheme.

After it has been obtained the reference signal, $i_{s, ref}$, the switching signals are generated as shown in fig 2. The resulting control method requires minimum current measurements.

It could be used a non-modulated control technique, which generates directly the switching signals named hysteresis band, which is based in non-linear feedback loops with comparators. Switching signals are generated when the tracking error exceeds a determinate tolerance band.

EXPERIMENTAL RESULTS

It has been used a neutral-pointed-clamped, VSI as the corrector. Each inverter branch is connected to the electrical system through three inductors (L_{FA}). All the elements values are shown in table 1.

Table 1. - Values of the conditioner parameters.

U_{FN}	L_{FA}	C_1	c_2	R_{L1}	R_{L2}	$U_{dc, ref}$
25	28	20	10	48	200	80

The results are shown in the figures (3), (4) and (5), in which it is noticed U_{pcc} , i_{La} , i_{sa} , i_{FAa} . The vertical scale is 100 V per division for voltage and 2 A per division for currents in all figures.

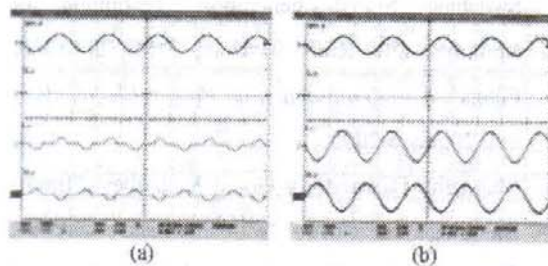


Fig.3. Results in oscilloscope operating as a Synchronous Rectifier. a) OFF mode b) ON mode.

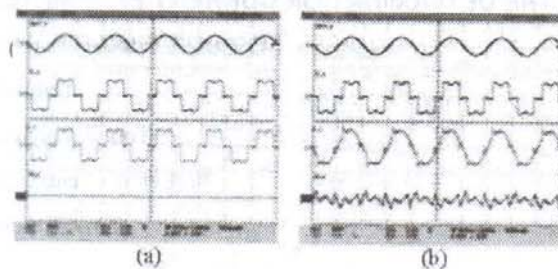


Fig.4. Results in oscilloscope operating as a Inverter or Active Filter. a) OFF mode b) ON mode.

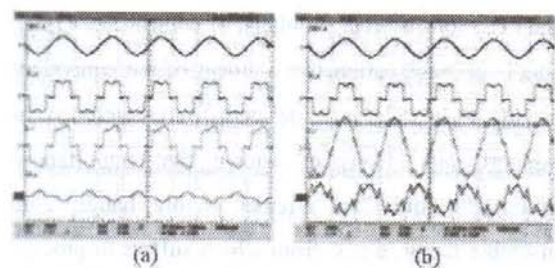


Fig.5. Results in oscilloscope operating as a Hybrid System a) OFF mode b) ON mode.

The operation mode as Synchronous Rectifier is shown in fig.3, the working process as Active Filter in fig.4 and, finally, the Hybrid System operation in fig.5.

CONCLUSIONS

It has been proved how the same control strategy could be used for a correct performance in the three operation modes of the conditioner system. This control strategy only needs to measure the supply current.

REFERENCES

1. E. Romero, M. Milanés, F. Barrero. "A modified Switching Signal generation Technique to Minimize the RMS Tracking Error In active Filters". *IEEE Transaction on Power Electronics*, vol. 20, no. 5, 2005.
2. Manjusha Dawande, y Gopal K. Dubey. "Bang-Bang Current Control with Predicted Switching Frequency for Switch-Mode Rectifiers", *IEEE Transactions on Industrial Electronics*, vol. 46, no. 1, 1999.
3. Don A. G. Pedder, Andrew D. Brown J. Neil Ross, y Alan C. Williams. "A Parallel-Connected Active Filter for the Reduction of Supply Current Distortion", *IEEE Transactions on Industrial Electronics*, vol. 47, no. 5, 2000.
4. Sato Yukihiro, Takeshi Kawase, Masamitsu Akiyama, y Terao Kataoka. "A control strategy for general-purpose active filters based on voltage detection". *IEEE Transactions on Industry Applications*, vol. 36, 2000.

THE DETERMINATION CURRENT PARAMETERS ELECTRIC MODE TO TRANSMISSION LINE FOR BUILDING ITS T-FORM ADAPTIVE MODEL

Dzhumik D.V.

Tomsk Polytechnic University

30, Lenin Avenue, Tomsk, 634050, Russia

E-mail: dzhumik@tpu.ru

For present-day day more actual is a problem of the fullness and validity parameters electric mode and parameter of the equivalent circuit of the transmission line (TL) for different problems of control line [1, 2]. This is because parameters element of the equivalent circuit, as a rule, are defined from reference or passport data. However known that importances parameters equivalent circuits greatly hangs from ensemble factor, a part from which suffers in process of the usages significant change, for instance because of influence changing weather conditions on losses of the corona TL and intensity of their cooling, because of presence of the fitting from wire of the other marks, inexactnesses of the task average geometric distances between phase at calculation of resistivity, mistakes at determination of the length to lines (for

instance, at presence branch), influence of the electric mode to lines etc. In too time in power system broadly become be used different recorders of the emergencies, "rememberring" that or other arrays counting out the control values.

In report is discussed way of the determination parameters to T-form model (the drawing 1), including either as in [2] measurement of instant importances signal voltages and currents at the beginning initially and at the end to lines and transmission array with the end of the lines in its begin on optical or radio-frequency channel relationship.