

HARDWARE AND SOFTWARE OF A BIPOLAR CURRENT SOURCE CONTROLLED BY PC

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ABSTRACT

This paper describes a realization of a bipolar current source developed by the paper authors. The source is intended for the application in galvanic and other industrial plants where pulse-reverse current supply is required (with the desired shape in time). A prototype of the device which provides the outcome current intensity up to ± 50 A, has been constructed. The hardware of the source consists of a PC Pentium IV, a commercial ADDA converter, an interface of authors' original construction as well as a current regulator. The application software is developed using a commercial packet LabView as the basis.

Key words: bipolar current source, interface, hardware, application software, PC control

1. INTRODUCTION

In advanced industrial plants, primarily in galvanic plants, the current sources are often necessary, with fast and simple change of the current direction and the intensity; what is more, with the desired shape in time [1]. Due to development of electronic and computer equipment, there has been opened a great number of possibilities for obtaining the optional shape of the voltage or the current, accompanied by the complete automation of the process and the introduction of the necessary feedbacks for the sake of eliminating the system disturbances.

In this paper there has been described the realization of such a system – bipolar current source with the possibility to set time intervals and current intensities either in one or the other direction. The system is based on the Pentium IV computer as well as the software platform LabVIEW, and the hardware interface, the current regulator and the software applications as the result of the own development.

2. HARDWARE

For the sake of signal generating as well as response monitoring of the galvanic system, there has been developed the measurement and control system on the basis of the PC Pentium IV. The hardware part, besides the computer, includes the commercial ADDA converter, the external interface for an analog signal processing and a powerful current source controlled by the voltage.

For ADDA conversion there has been used the commercially available converter Burr-Brown PCI-20428W [2]. In fact, it is a 16-channel AD converter with a 12-bit conversion, that is, the two-channel DA converter, also with a 12-bit conversion. Besides the above mentioned analog channels, the board also has the digital outputs and inputs, the generator of square signals and a 16-bit counter.

The measurement and control interface provides the link between the computer and the process. The signal conditioning is also performed in it. Its block-scheme is given in Figure 1.

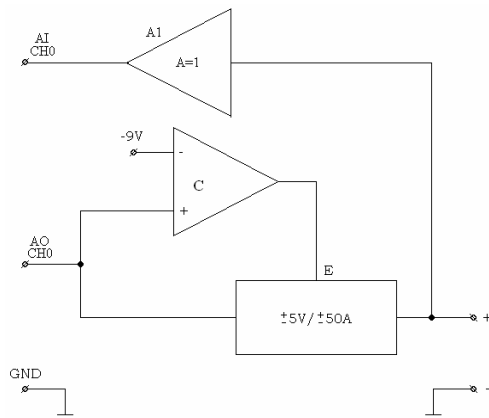


Figure 1: Block scheme of interface

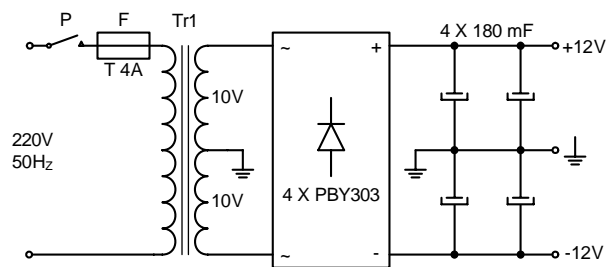


figure 2: The scheme of the main supply ± 12 V

The given shape of the controlling signal is being taken from the analog output – channel 0 (AO – CH0) to the comparator (C) which gives the enabling signal (E) to the outgoing block (± 5 V / ± 50 A) under the condition that the controlling voltage is within permitted limits, i.e. the system is initiated. In that way, the output is being blocked up to the end of the process of initiating the system, in order to avoid uncontrolled load current while switching on.

On channel AI0, the load's voltage is being brought in the ADDA converter so that the system response can be monitored, that is the voltage on the load.

The second analog output of ADDA converter can be used for superposing of DC component with the given shape of the signal. Some other input channels can also be used for taking in the feedbacks as well as monitoring the system parameters (for instance, the temperature).

The assemblies of the current source governed by a voltage will be demonstrated in more details. For the controlling voltage within the range of ± 5 V, it provides the current within the range of ± 50 A at the output. The regulator is of a proportional kind with a filter for avoiding the self oscillation.

The scheme of the main supply of the system has been shown in Figure 2. In fact, it is the classical bipolar rectifier assembly which provides unstabilized voltage of ± 12 V with the current of up to 50 A. The stabilization is not necessary as the rectifier supplies the current source [3]. The element values are given on the scheme.

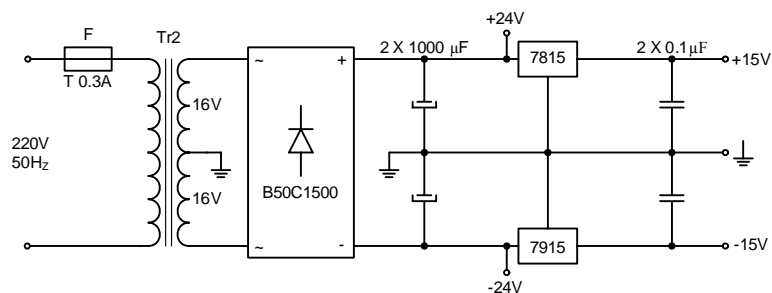


Figure 3: The scheme of additional supply

For the supply of the measurement and control electronics, the rectifier ± 24 V has been used with the stabilization of ± 15 V, whose scheme is given in Figure 3, with all element values.

The scheme of the current regulator is given in Figure 4. The signal of an error (the difference between the given and measured current) has been intensified by 100 times in a block containing the operational amplifier A1 (type 741) [4]. The amplified signal, through the transistors T1 – T7 (BC547

NPN and BC 212 PNP), open one or another group of output MOSFET transistors (T8 – T11 or T12 – T15) providing in that way one or other direction of the output current, in accordance with the controlling voltage. The transistors type IRF1010 has been used, four in parallel operation, with the corresponding coolers and forced air cooling. For output current monitoring, the module LEM ± 50 A (CSNP661, Honywell) has been applied, and the values of all passive elements are given on the scheme itself.

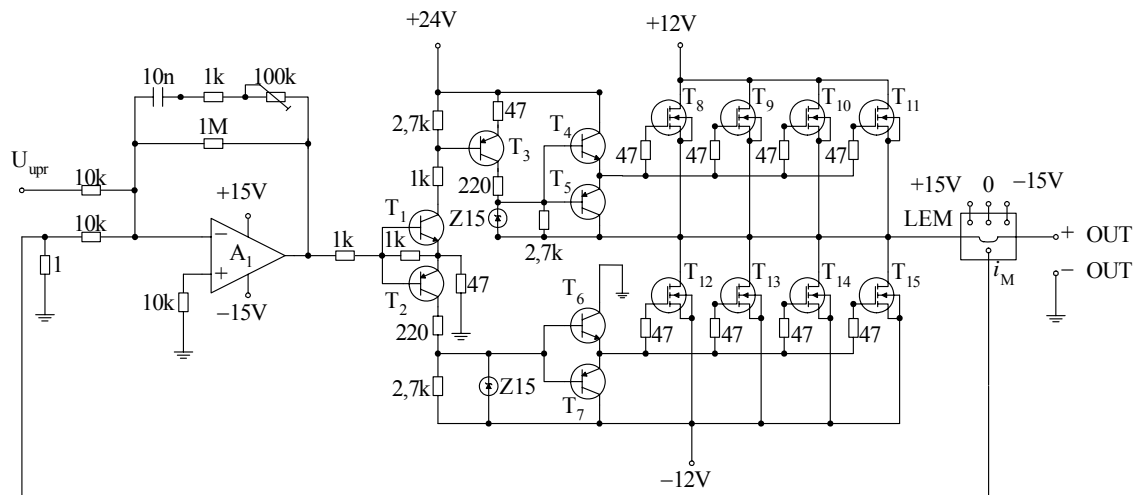


Figure 4: The scheme of current regulator

3. SOFTWARE

The software platform was the packet LabVIEW (National Instruments) [5, 6] which is valued for the high standards in the world of measurement technique and virtual instruments.

For the connection with ADDA converter, that is, with the external world, there has been used the Master Link collection of the drivers which is provided with the converter PCI – 2048 W.

By the installation of these two packets as well as ADDA board, one can get a very powerful development system for measurement, control and signal processing (virtual instruments).

The graphical users' interface has got two windows: **Control panel** – for the control and monitoring of the process (the user of the application uses this window) and the **scheme of application** – shows the used virtual instruments, the connections between them, the course of the signal and the error detection.

In Figure 5 it is shown the example of the control panel for the case of a rectangular shape of the current in both directions with the possibility to adjust the time of duration of pulse (t_p), pause (t_0) and reversion (t_r), as well as the current intensity of the pulse (I_p) and reversion (I_r). On the figure displays there are shown the actual values of the current, voltage and time and on the graphical display one can monitor the response (the voltage of load) in time. The measured data are being recorded in the form of a table in a file, whose name the user puts in the determined field on the panel. It is possible to have a manual or automatic choice of the graphical display scale.

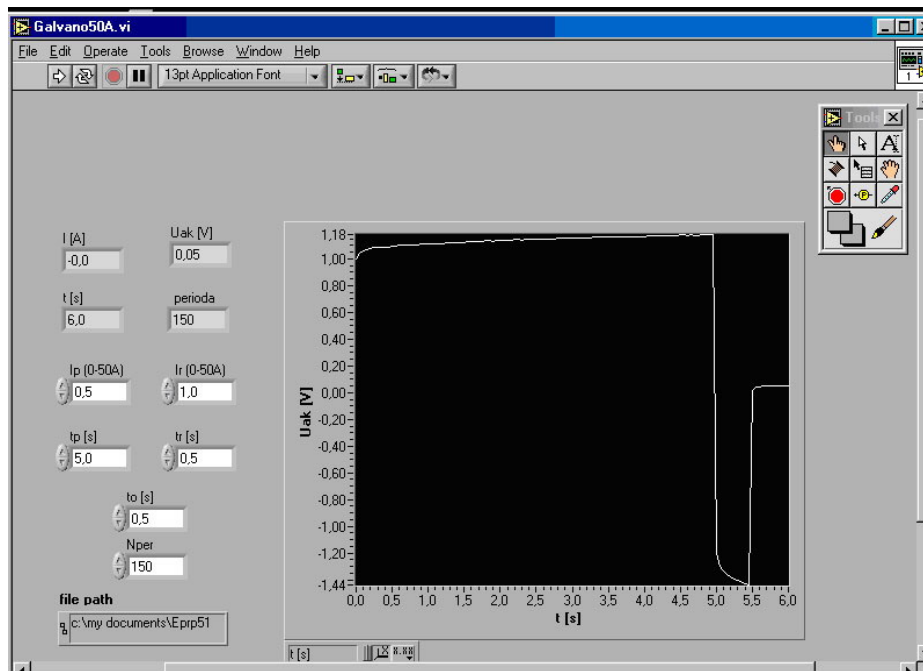


Figure 5: Control panel

By the controls t_p , t_r and t_0 there have been adjusted the time of pulse, reversion and pause respectively; and by the controls I_p and I_0 the corresponding currents. In the shown WHILE loop, it has been monitored the time and it has generated the voltage at the output block AOWrite (channel AO0). It is a controlling voltage for the interface where the conversion of voltage into current is done. After the process of amplifying is being done, on the output there has been obtained the current which has been set by the software. The voltage measurement is done on the channel AI0. After N sampled values in FOR loop there has been performed the mean (Mean), displaying (U_{ak}) and memorizing of the measured voltage. The graphical display of voltage in time is also given (Wave form).

4. CONCLUSION

There has been constructed, calibrated and tested the prototype of the described bipolar current source not only of its hardware but also the software application for the rectangular, triangle and stepwise form of the current in time. The system has been tested with different types of loads with different shapes of output current in millisecond and second range. All the tests showed remarkably well behavior of the system, that is, a very good stability and correctness.

5. REFERENCES

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