Automation of testing modules of controller ELSY-TMK

A E Dolotov[1]**, R G Dolotova**[1]**, D V Petuhov**[2]**, A P Potapova**[1]

[1] Tomsk Polytechnic University, 30, Lenina ave., Tomsk, 634050, Russia
[2] EleSy Company, 161 A, Altayskaya ave., Tomsk, 634021, Russia

E-mail: dolotovae@tpu.ru, dolotova@tpu.ru

Abstract. In modern life, there are means for automation of various processes which allow one to provide high quality standards of released products and to raise labour efficiency. In the given paper, the data on the automation of the test process of the ELSY-TMK controller [1] is presented. The ELSY-TMK programmed logic controller is an effective modular platform for construction of automation systems for small and average branches of industrial production. The modern and functional standard of communication and open environment of the logic controller give a powerful tool of wide spectrum applications for industrial automation. The algorithm allows one to test controller modules by operating the switching system and external devices faster and at a higher level of quality than a human without such means does.

1. Introduction

The ELSI-TMK controller is designed for the following purposes: measuring continuous signals presented by direct current voltage and (or) direct current, gathering and processing the data from primary sensors, forming control signals according to a specified algorithm, receiving and sending information through serial communication channels in systems of measurement, controlling and management of the oil and gas industry facilities, power facilities and facilities of other branches of industry, including energy consumtion audit both for commercial and technological purposes and development of security systems [2].

The controller is a restorable, multipurpose, multichannel item with a variable structure of functional modules and ability to back up the power supply and the central processor unit. Its special feature is an ability to apply the whole set of input-output modules and also to apply one or several interface modules connected by a switching panel. The TA715 module which is a part of the ELSY-TMK controller is designed for measurement of direct current voltage or for direct current.

The operation algorithm of the controller is defined by an operating program developed by the user according to requirements to the control system created by means of the controller. The basic area of application is the systems of automatic and automated control of manufacturing processes.

2. Materials and methods

The controller represents a set of modules (Fig. 1) connected by a switching panel which is designed for mechanical integrating of the controller modules, for organising the electrical connections between modules, and also for installating the controller on an installation site. Depending on the number of installed modules, the panel has some modifications. For the function of power supply back-up, some special variants of modification are provided. The object-to-be-tested is the controller of the TA715 module designed for measurement of direct current voltage or for direct current. The TA715 module is

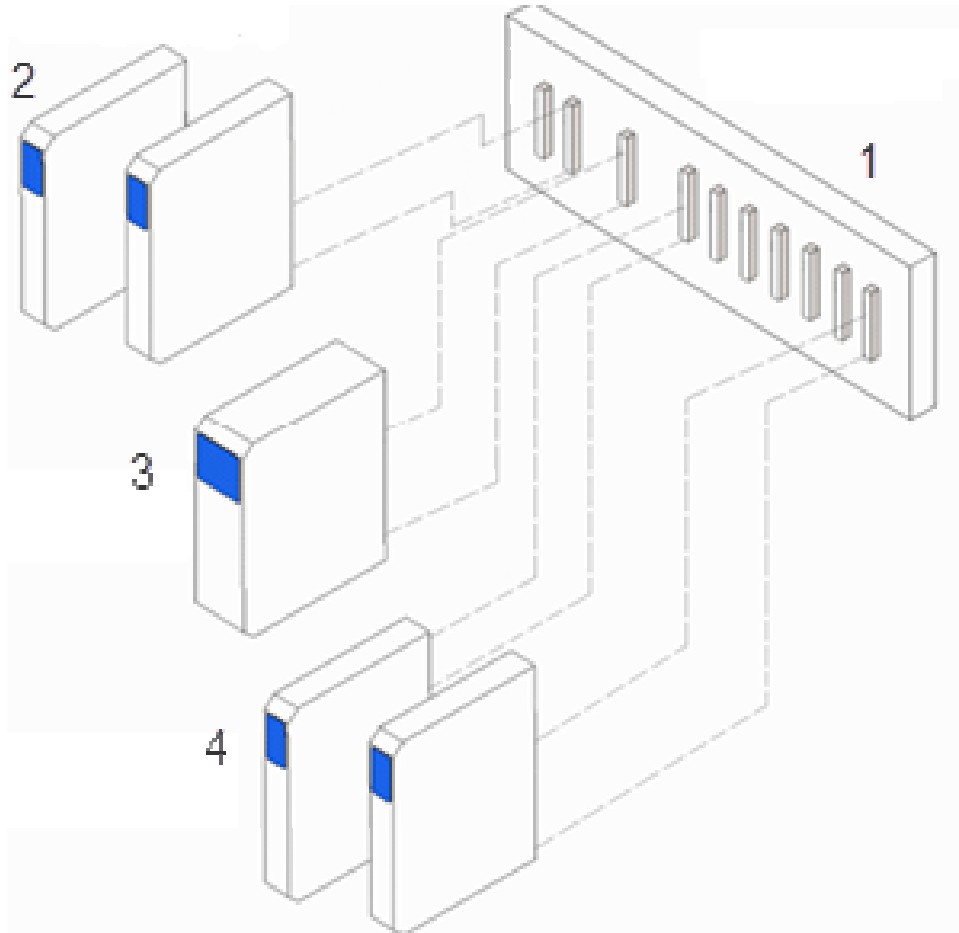a part of the controller programmed by the ELSY-TMK [3-6].

Figure 1. A controller. A hardware structure: 1 - switching panel, 2 - power supply, 3 - processor module, 4 - functional modules.

The controller is realised on a modular approach on the basis of a parallel highway. The controller highway contains the following parts: an address bus, a data bus, a control bus, an interrupt bus and a power bus. Controller modules are connected to the bus in parallel and they exchange data with the processor by means of the highway and also are connected to the power voltage. The controller power supply transforms voltage of power from *220* B/*50* Hz or *24* in direct current to a supply voltage of modules: plus *5*, plus *12*, minus *12* B.

The controller software is based on the *CoDeSys* development system by the company "3S-Smart Software Solutions" designed for controller programming in languages according to the IEC 61131-3 standard. The base structure of the *CoDeSys* complex includes two systems: a development system and an execution system. The development system runs on a PC and represents a tool for designing, system configuring and operating program code development for the programmable logic controller. The execution system (ES) runs on the controller and provides the code loading of the applied program in the controller, execution of the operating program and executing of debugging functions. The base version of *CoDeSys* is specially adapted for operating on the ELSI-TM controller. In addition to available tools of the complex, the add-in components of the controller support are developed for the most effective development of application programs.

3. Automation of voltage tests of a TA75 module

For automation purposes, the connection and control of an industrial computer were established with the object-to-be-tested and the calibrator on the test bed (Fig. 2).

Figure 2. The test bed of the ELSY-TMK controller: 1 - a table of the tester, 2 - an industrial computer, 3 – a system of signal switching, 4 – a unit for specifying the external voltage (SA100calibrator), 5 – a monitor, 6 – a keyboard, 7 – a special demountable connector of the switching system, 8 – an ELSY-TMK controller with extension modules as an object-to-be-tested.

The test bed is designed for automatic tests of extension modules of the TA715 analogue input terminals, the TD711 digital input terminals, the TD712 digital output terminals of the ELSY-TMK controller. The control of the controller is carried out with the Modbus tcp/ip interface. The signals from the switching system pass to the extension modules of the controller. The switching system represents sets of relays controlled by means of the industrial computer through the DIO144 expansion card. There are controlling and individual relays. By means of controlling relays the signal wire commutes with one of the external devices that set the voltage: the Advantage card, TMA, the CA100 calibrator. By means of controlling relays the signal is inverted, and also the signal wire is closed with the 680 Ohm and 6.8 kOhm resistors. Individual relays commute the signal wire to one of channels of a specified extension module.

For example, for testing of the TA715 extension module for the current, the signal from the external setting device is commuted by the system to one of the input terminals of module analogue channels. Each channel of this module is checked in series. Also all other channels must not have any connection to the signal wire. The test process control is carried out by the industrial computer with installed software. The algorithm of the given program allows conducting tests of three types of extension modules. External setting devices, such as a SA100 calibrator and a TMA calibrator, are controlled through a COM-port. The Advantage card is controlled through a demountable ISA

connector.

All TA715 analogue channels should be tested for the given admissible relative error of voltage value. If any channels of the module do not pass the test for the given error, the information about the damage of specified channels is displayed along with the information about the given relative error at the specified voltage level. Further, the tester removes the module from the switching panel, prepares the report and starts testing of the next module.

After the start of the executable file of the test software, there is a readjustments of basic connection elements with the object-to-be-tested and testing tools. By pressing the button "Connect", the tester starts the procedures that establish connection with the controller through modbus tcpip [7]. To operate the modbus interface, the free library "libmodbus" is used. From the ComboBox1 element a peripheral device is chosen, from which the analogue power will pass: the Advantach card, TMA or the CA100 calibrator. After the start of "TA715 voltage test", the main algorithm function of testing of the module of analogue input terminals is executed. In the boot record, the initial values of all main function variables of the testing algorithm are defined.

4. Conclusion

The developed software allows conducting tests of extension modules of the ELSY-TMK controller. The tests of the TD712 module of digital output were carried out by means of the verified module of digital input terminals - TD711 module. The automatic mode of tests of the TD712 module output channels is carried out by connecting the buses of the digital input terminals of the TD711 module with digital output of the TD712 module and by starting the "Test TD712" program on the industrial computer.

The testing means software sequentially shorts the TD712 module channels one by one by changing the value of the register bit which is responsible for the state of this channel. The register value is changed by sending the write instruction under the modbus tcp/ip protocol. If the bit is equal to 1, the current passes through the channel. It can influence the corresponding channel of the TD711 module of digital input terminals. This can be checked by reading the corresponding register with the modbus tcp/ip. The current information about the testing of module channels is displayed on the screen.

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