

USING ADAM MODULES IN INDUSTRIAL AUTOMATION

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Abstract: In this time there are no industrial process working without automated control systems. The technologies development and the miniaturization of the components lead to the production of a large number of systems for process automation based on microprocessor systems. The 4000 series ADAM modules are input/output modules with RS485 communication protocol.

Keywords: industrial process, automated control systems, ADAM modules, RS485 communication

1. Introduction

To implement the automated system for an industrial process can choose one from the follow methods:

- the implementation of the control algorithm using a simple PLC controller or a complex PLC as CompactRIO type. CompactRIO platform features highly integrated software, a range of performance and form factor options, and extensive I/O to reduce risk, boost system performance, and simplify the design of advanced embedded control and monitoring systems. CompactRIO [1] is an advanced embedded control and monitoring system that includes a real-time processor, an FPGA, and hot-swappable C Series modules. CompactRIO is programmed using LabVIEW system design software. Because CompactRIO is a distributed real-time system, it also uses the LabVIEW Real-Time Module and, optionally, the LabVIEW FPGA Module. CompactRIO also requires that you install the NI-RIO driver on your development PC to support the various CompactRIO real-time controllers, reconfigurable chassis, and C Series modules. This same installation

procedure applies for Single-Board RIO and R Series multifunction RIO targets. The main disadvantage of this method if the highest price and the need of specialized personnel to program such PLC's.

- the implementation of the control algorithm on a computer and placement to the field of a simple acquisition and command modules which communicate with the automation software application. Such modules are the RS-485 I/O Modules ADAM-4000 series products by Advantech. Advantech's RS-485 I/O Modules, ADAM-4000 series, [2] are the perfect choice for establishing a cost-effective remote I/O system. Customers can benefit from ADAM-4000 modules through its simple wiring using only two wires to communicate with their controller or other RS-485 devices. ADAM-4000 modules use the EIA RS-485 communication protocol, the industry's most widely used bi-directional, balanced transmission line suitable for industrial environments.

2. The automation system topology

To test the operation of an automated system using the 4000 series ADAM modules was created a laboratory platform to simulate the control of an industrial process. The block diagram of the implemented platform is presented in figure 1.

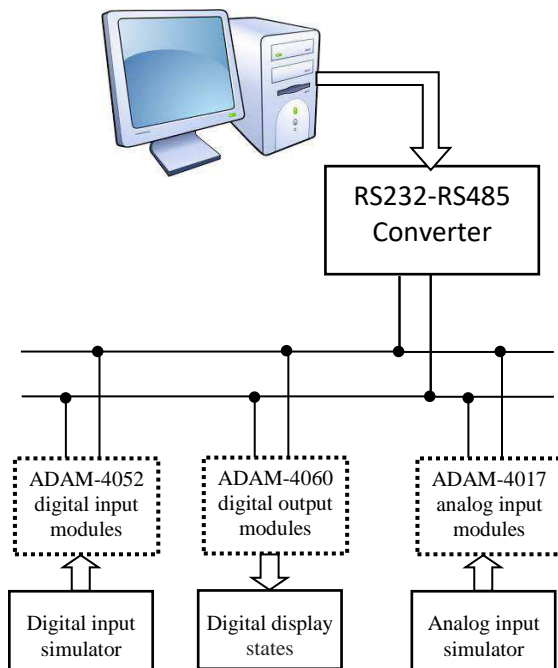


Fig.1. The system structure

In ADAM series, the baudrate can be configured from 1200 bps to 38.4 Kbps. The baudrate of all modules in an RS-485 network must be the same.

When the host computer or terminal has only a RS-232 port, an Isolated RS-232/RS-485 Converter, connected to the host's RS-232 port, is required [1].

Before placing a module in an existing network, the module should be configured. Though all modules are initially configured at the factory, it is recommended to check that the baud rate is set correctly. Default Factory Settings is:

- Baud rate: 9600 Bit/sec.
- Address: 01 (hexadecimal)

3. The digital input

To read the digital inputs can be used the follow types of digital modules [3]:

- ADAM-4050 Digital I/O Module - seven digital input channels and eight digital output channels. The outputs are open-collector transistor switches that you can control from the host computer. Also may be used the switches to control solid-state relays, which in turn can control heaters, pumps and power equipment. The host computer can use the module's digital inputs to determine the state of limit or safety switches or remote digital signals.

- ADAM-4051 16-channel Isolated Digital Input Module - built with 2500VDC optical isolation, it is suitable to critical applications. Different from other modules, the ADAM-4051 accept 10 ~ 50V input voltage to fit various digital signals, such as 12 V, 24 V, 48 V. Moreover, may be read the current status from the LED indicators on the front panel.

- ADAM-4052 Isolated Digital Input Module-- provides eight digital input channels: six fully independent isolated channels and two isolated channels with a common ground. All have 5000 VRMS isolation to prevent ground loop effects and prevent damage from power surges on the input lines.

- ADAM-4053 16-channel Digital Input Module -- provides 16 digital input channels for dry contact or wet contact signals. For dry contact, effective distance from DI to contact point is up to 500 m.

- ADAM-4055 16-channel Isolated Digital I/O Module-- offers 8-ch. isolated digital input and 8-ch. isolated digital output for critical applications. The inputs accept 10~50V voltage, and the outputs supply 5~40VDC open collector. Considered to user friendly, the ADAM-4055 also built with LED indicator for status reading easily.

On the implementation was used two ADAM-4052 Isolated Digital Input Modules with the follow features: 8 Channels (6 differential and 2 single ended)

with logic level 0: +1 V max. and logic level 1: +3.5 V to +30 V

On the system board was used 5 differential digital inputs from each module and, for simulate the inputs, was used switches with 2 positions and LED's to indicate the state of each simulated input. The electronic schematic of the module used to simulate the 5 digital inputs is presented in figure 2.

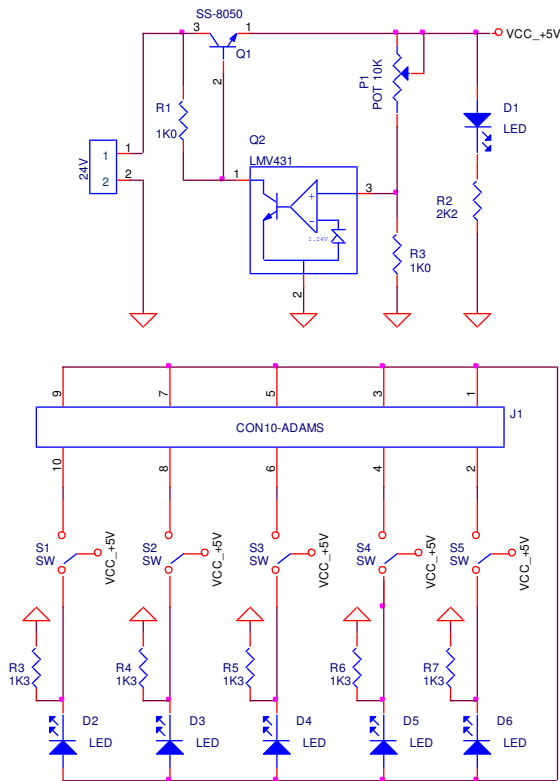


Fig.2. The digital inputs simulator

4. The digital output

For digital commands are available 2 types of modules, both with relay output: ADAM-4060/4068 Relay Output Module. The ADAM Relay Output Module is a low-cost alternative to SSR modules. The ADAM-4060 Relay Output Module provides four relay channels, two of Form A and two of Form C. The ADAM-4068 Relay Output Module provides eight channels, four of Form A and four of Form C. These two modules are excellent for ON/OFF control or low-power switching applications.

On the system board was used two ADAM 4060 series module having contact rating

for Form A and Form C: AC 0.5 A / 120 VAC, DC: 1 A / 24 VDC.

The digital outputs are two with relay contact NC (channel 0 and 1) and two with relay contact NO and NC (channel 2 and 3). To indicate the state of the outputs was mounted LED's as:

- Yellow LED's for channel 0 and channel 1 which indicate by ON state the closed contact, and by OFF state the open contact
- Red and green LED's, one for each channel 2 and 3, which indicate by green LED on the closed contact and by red LED on the open contact. The electronic schematic of the outputs modules is presented in figure 3.

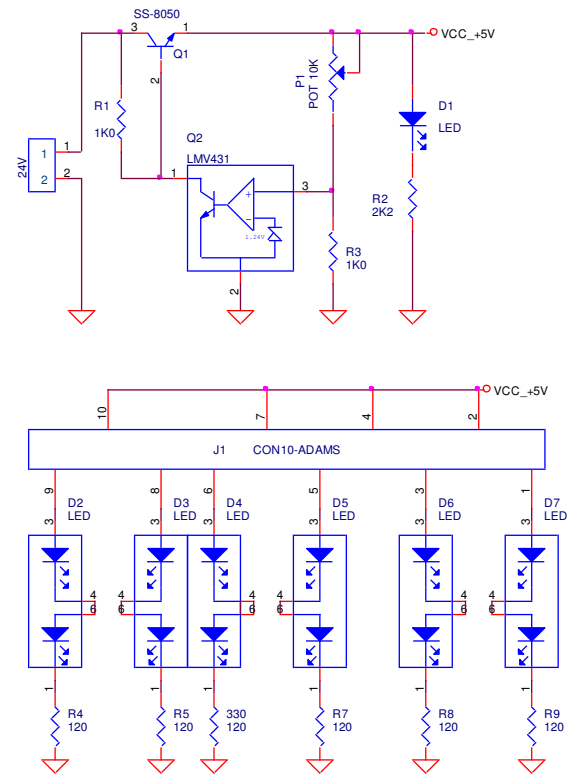


Fig.3. The digital output states

5. The analog input

To read the analog inputs can be used the follow type of modules:

ADAM-4017/4018 8-channel Analog Input Module. The ADAM-4017/ 4017+/ 4018/ 4018+ is a 16-bit, 8-channel analog input module that provides programmable input ranges on all channels. This module is an

extremely cost-effective solution for industrial measurement and monitoring applications. Its opto-isolated inputs provide 3000 VDC of isolation between the analog input and the module, protecting the module and peripherals from damage due to high input-line voltages. ADAM-4017/4017+/4018/4018+ offers signal conditioning, A/D conversion, ranging and RS-485 digital communication functions. The module protects your equipment from ground loops and power surges by providing optoisolation of A/D input and transformer based isolation up to 3000 VDC. The ADAM-4017/4017+/4018/4018+ uses a 16-bit microprocessor-controlled sigma-delta A/D converter to convert sensor voltage or current into digital data. The digital data is then translated into engineering units. When prompted by the host computer, the module sends the data to the host through a standard RS-485 interface.

On the implementation was used two modules ADAM 4017 type with the follow technical features [3]:

- Channel 6 differential, 2 single-ended
- Input Type mV, V, mA
- Input range +/- 150 mV, +/- 500 mV, +/- 1 V, +/- 5 V, +/- 10 V, +/- 20 mV, 4 ~ 20 mA
- Isolation Voltage 3000 VDC
- Fault and overvoltage protection
- With stands overvoltage up to +/-35 V
- Sampling Rate 10 sample/sec (total)
- Input Impedance 20 M Ω
- Accuracy +/- 0.1% or better
- Power Consumption 1.2 W
- I/O Connector Type 10-pin plug-terminal

The electronic board for simulate the analog inputs was implemented for 5 from 6 differential inputs of each module. For a wide range of input signals was implemented for this module two voltage regulators. One of voltage regulator provides the VL voltage to the negative input of the differential channel and the second voltage regulator provides the VH voltage for supplying the potentiometer P1-

P5 by which is applied on the positive input of the differential channel a variable signal. If the potentiometer cursor is on the lower part the $V_H=2V_L$ and is a negative input signal. If the potentiometer cursor is on the middle the signal is 0, else if the potentiometer cursor is on the higher part the signal is a positive input signal.

By changing the output voltages of the voltage regulators can be achieved various working ranges depending on working range set by ADAM 4017 module.

The electronic schematic of the simulator of the analog inputs is presented in figure 4.

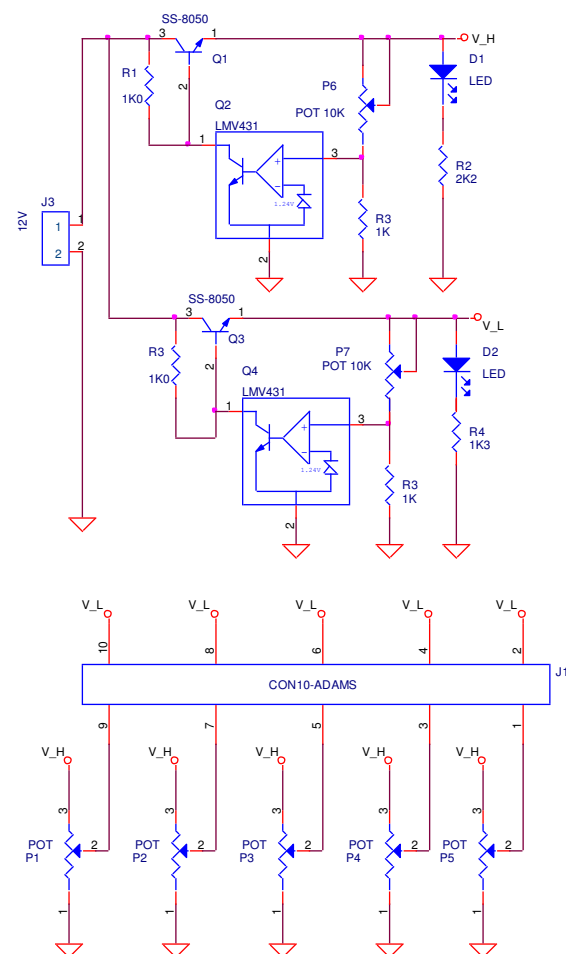


Fig.4. Analog input simulator

6. The ADAM-4000 Utility Software

The ADAM modules can be set using a simple utility software with the following capabilities:

- Module configuration
- Module calibration

- Data Input and Output
- Alarm settings
- Autoscan of connected modules
- Terminal emulation

The main screen consists of a menu bar at the top side of the screen and a status field which displays information about the connected modules. When first start the program, it will automatically scan for any attached modules and display their data. The status field lists module characteristics, module configuration parameters and input or output values. Normally must use the Search command to scan the network. Highlight the Search command on the menu

bar and press <Enter> (or simply press the “s” key). The “Search Installed Modules” window will then appear to prompt you to enter the range it should scan. Input a value 0 and 256 decimal.

Select Setup from the top bar and a selection bar will appear in the status field. First, move the selection bar over the module you wish to configure and select it by pressing <Enter>. A configuration screen will appear with the settings available for its module type and the current values of its inputs. An example is shown in Figure 5 for an ADAM-4017 module.

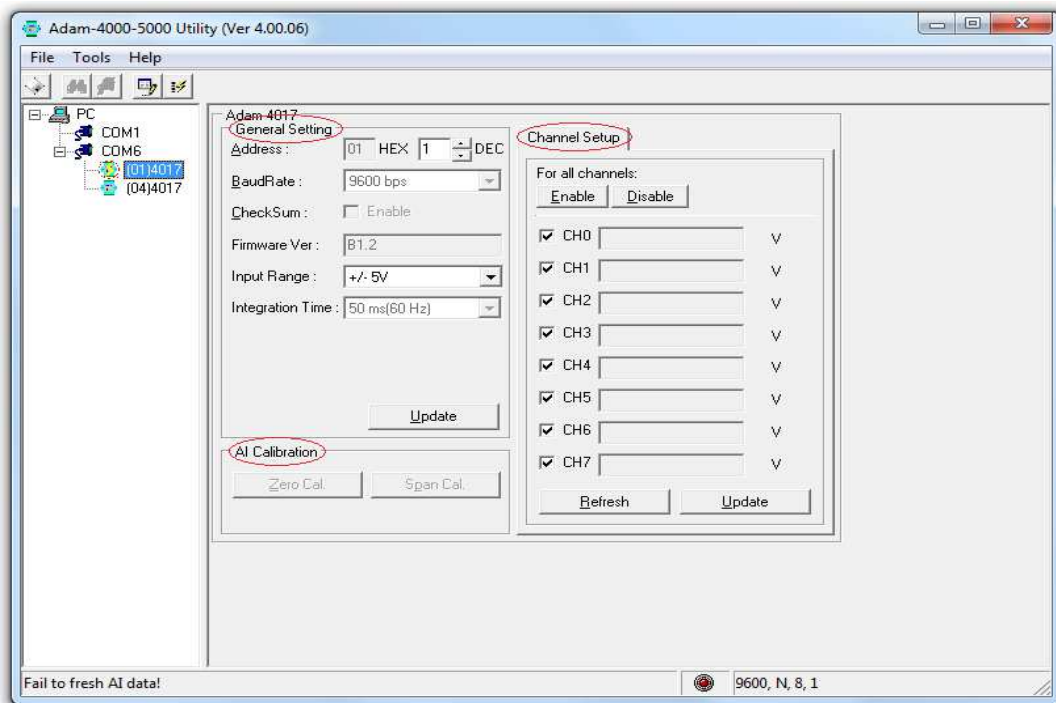


Fig.5. The ADAM 4017 Setup Module

CONCLUSIONS

The ADAM modules are simple to use modules which make them suitable for laboratory platforms to learn how to control and command an automatic process. Using this modules every graduate engineer which learn about programming, electronics, and automatic control system can make a simple automatic system to automate control a process. The simulator platform implemented on laboratory, presented in figure 6, help students to

practice how to work with simple automatic systems based on ADAM modules. Even if the implemented platform each has only two modules for digital inputs/outputs and analog inputs, ADAMS manufacture a wide type of modules as analog input/output module, counter/Frequency input modules, thermocouple input module, RTD input module, strain gauge input module which can be connected to the existing network.

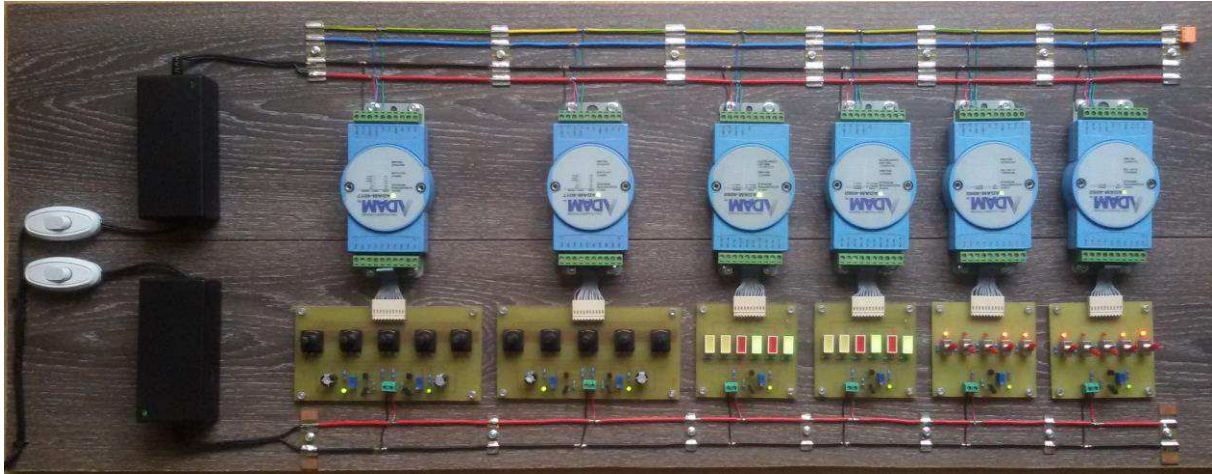


Fig.6. The system simulator with ADAM modules

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