PC DRIVEN INTEGRATED VACUUM SYSTEM

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ABSTRACT

The paper presents a integrated vacuum system which was designed and manufactured in our institute. The main parts of this system are the power supply unit for turbo-molecular pumps and the vacuummeter. Both parts of the system are driven by means of a personal computer using a serial communication, according to the RS 232 hardware standard.

1 INTRODUCTION

The integrated vacuum system are utilised in many technological plants. A lot of experiment from physics or chemistry needs boxes without any kind of gases or organic residual matters. Also many technological processes from electronics and pharmaceutical industries for to progress in good conditions, need a clean and ultrahigh vacuum. Sometimes these plants cover a big area, with high distances among workstations, or they are in the dangerous areas and a remote control is necessary.

In our institute we are using many vacuum system manufactured by well-known producers: Edwards, Balzers, Leybold.

Because these devices are not enough for our needs and they are very expensive for us, we had to design and manufactured by ourselves some of them, according to the main demand: remote control with an IBM PC. For this reason the device must be an intelligent one, provided with a microprocessor or a microcontroller. We fulfilled these requirements, building a integrated vacuum system. Both parts of the system, power supply unit for turbo-molecular pumps and the vacuummeter, are controlled by 80C31 microcontroller.

Because this microcontroller has a built-in circuitry for a serial communication, we established a serial communication between the PC (Pentium-166 MHz) and the power supply unit for turbo-molecular pumps and the vacuummeter, according to the RS-232 hardware standard. Optimum selection of software development tools, however, was not as straightforward. Most producers use the C/C++-language programming tool for developing instrument drivers for their intelligent devices. One of the advantages of C/C++ is its speed, but the compilation and the high-level skill required for optimum programming do not fair well with some requirements, particularly those of versatility, upgradability, and user friendliness. After careful evaluation of several options, a final decision was to develop a hybrid software package using two different software development tools: LabVIEW, and assembly language. We chose LabView because it is dedicated to data acquisition and communications, containing libraries for data collection, analysis, presentation and storage.
2 PRESENTATION OF THE INTEGRATED VACUUM SYSTEM

Figure 1 shows the block diagram of the integrated vacuum system. This allows the command of backing pump with closing the valve control on the vacuum ways and depending of the signal provided by vacuummeter it commands the start/stop for the turbo-molecular pump. The main blocks of this diagram are the following:

Figure 1: Connecting POWER SUPPLY and VACUUMMETER to PC
- Power supply unit for turbo-molecular pump which supplies in direct current the coils of the windings. The commutation of coils has been realized in signal track provided from the position transducers system with Hall probe. This unit is commanded with 80C31 microcontroller which fulfils the following functions: measure a frequency $F_i$ which is proportionally with the motor rotation speed, effects the convert and displays the result; make a strict control of the motor rotation speed between lower and upper limits and disconnects the electric supply of turbo-molecular pump when some working parameters of motor are exceeded (currents, temperatures, vibrations).

- Vacuумmeter which is utilised for pressure measurement. This has two domains corresponding for two gauges. For $1 \times 10^{-3}$ mbar it is used a thermal conductivity gauge and for $10^{-3} \times 10^{-8}$ mbar it is used a ionisation gauge.

2.1 FRONT PANEL OF POWER SUPPLY UNIT

In figure 3 is presented the front panel for power supply unit which ourselves realized. Clicking by mouse in the frame we can realise the following functions:
- setting the START HOUR and STOP HOUR for turbo-molecular pump;
- displaying the ROTATION SPEED for turbomolecular pump;
- setting the rotation speed value: NOMINAL or STAND BY value;
- supplying the heater for degassing of pump;
- enabling or disabling the serial communication.

Figure 2: The VI front panel for power supply unit
2.2 FRONT PANEL OF VACUUMMETER

We tried as much as possible to keep the same look for the VI front panel, like the front panel of the real vacuummeter. In the figure 3, it can be noticed a virtual keyboard with twelve keys, a simulated LCD display, and two charts. This virtual keyboard is used to set the measurement parameters for the vacuummeter, and for starting data acquisition. Clicking with the mouse on the keys 1...9, the specific submenus are displayed. These submenus consist in:

- changing the pressure measurement units; mbar, pascal or torr
- displaying the parameters for ion gauges; electrons current, ions current and cathode heating current
- selecting the value of cathodic emission current for the ion gauge 2; 200 µA or 2 mA
- setting the measurement correction coefficients in respect with the gas (helium, nitrogen, oxygen) at low pressure
- selecting the working ion gauge; gauge 1, gauge 2, or both
- ion gauge 2 degassing
- enabling or disabling the serial communication
- switching on-off the display backlight
- displaying status parameters of the vacuummeter; voltage to frequency conversion accuracy, power supplies voltages
- testing the electrometer amplifier of the vacuummeter

![Figure 3: The VI front panel for vacuummeter](image-url)
2.3 BLOCK DIAGRAM DESCRIPTION

As it is shown in figure 4, when the VI starts running, the serial port is initialised at 2400 baud, 8 data bits, 2 stop bits, and no parity. After that, the virtual keyboard is scanned. If no key is pressed, the VI executes a while loop in which data are continuously received from vacuummeter. The data are the result of pressure measurement with ion gauge 2. The received string is displayed after the control characters were rejected. For displaying the result on the chart, this string is converted into a number (engineering notation). If one key is pressed, excepting ESC, the VI will execute the next frame. But, before that, the VI bundles all the Boolean controls and converts the result into a floating number.

![Block Diagram](image)

Figure 4: Reading the virtual keyboard

3 CONCLUSIONS

The monitoring of industrial plants by virtual instrumentation represents the most modern trend in domain of electronic device. The integrated vacuum system has a lot of facilities, including the automatically storage of measurement results on the hard disk and providing warning message for operators when the measured parameters lower and upper than the fixed value. The system can also works stand-alone, receiving the commands from the keyboards placed on his front panel but, when it is included in a automation complex system, it is necessary a remote control from PC.
REFERENCES

