Control system of laser for plasma diagnostics.

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Modern methods of diagnostics and research require laser radiation with many different parameters. One of the tasks that arrose during creation of a complex for plasma diagnostics was the development of a control system for the radiation parameters of a tunable laser.

The control system for lasers was developed at our institute using a gauge to measure the radiation wavelength, a module for data aquisition and control and a module for data processing.

The module for data processing is a microprocessor module. Despite its simplicity it completely fulfills the technical requirements and can execute complicated operations of processing, converting and transferring data. The functional chart of this module is shown in figure 1.

The Z80 CPU provides the required mathematical calculations for the radiation parameters and generates commands for the control module. The 8751 micro controller is used for display, keyboard and serial input/output control, and contains a FIFO that receives and transmits data. The serial port can be connected to an IBM PC to be used as an operator workstation.

The distinct feature of the control module is the standard parallel interface, similar to the IBM PC printer interface. It allows one to connect one or several such modules directly to the IBM PC when necessary. The data exchange with the module is made by writing standard commands to the module registers and reading data from the registers. The exchange is done by means of 8-bit words.

This approach allows one to change the configuration of the system and to develop it step by step. The functions of the system are as follows:

- Analysis of the state of the laser plant
- Convertion of signals from the gauge and their analysis
- Controlling of operation modes of executive devices

The source of information is the wavelength gauge. Its optical system is shown figure 2. The radiation from a source 1 passes through a system of lenses 2 and through the Fabry-Perot interferometer 3. At the plane 4 an interference pattern consisting of light and dark circles appears. The coordinate sensitive gauge 7 mounted on transport platform 5 scans the interference pattern and gets information about circles. The platform 5 is moved by step driver 6.

Four identical zones are put on a uniform crystal substrate for the light sensitive element of gauge 7. Every zone generates an electrical signal proportional to the radiation exposure. The gauge forms a difference signal from two zones. It allows one to reduce the undesired influence of external light on the measurements.

For the definition of the length of the wave it's necessary to know two parameters; geometrical sizes of the optical system and diameters of the interference circles. Before the measurements with a tunable laser a calibration of the optical system needs to be conducted. For this the radiation of a stabilized laser is put into the optical system. Knowing the wavelength of the "reference" laser and the diameters of interference circles of the "reference" radiation and of the radiation of the tunable laser, one can calculate the wavelength.

The control software of the system was written for the IBM PC and does all functions mentioned below:

- provides automatic setup of system with "reference" and required wavelength
- supports switching of scanning modes
- makes periodic correction of tunable laser
- has a user interface

Experiments with the system have shown stable work with lasers with a range of tuning from 0.64 to 1.1 microns. The minimum period of scanning is from 50 seconds to 2 minutes in continuous scanning mode.

Literature.

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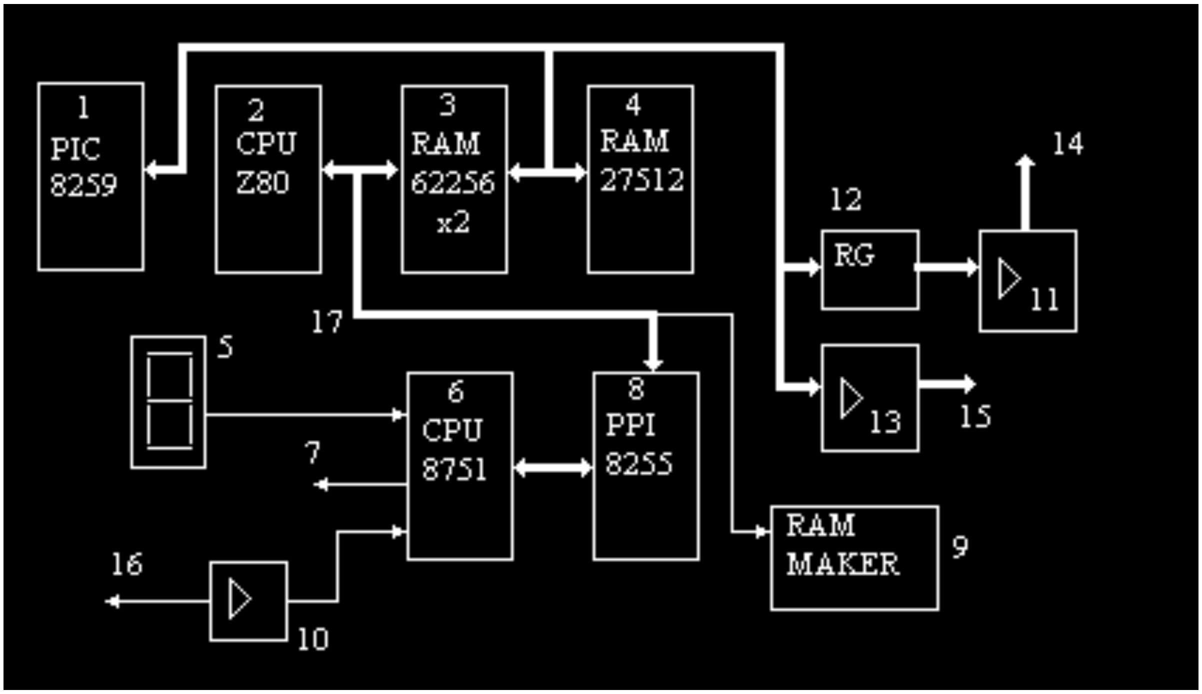

Fig. 1 The functional chart of data processing module:

1 - interrupt controller, 2 - central microprocessor, 3 - RAM, 4 - ROM, 5 - display, 6 -peripheral microcontroller, 7 - keyboard connector, 8 - peripheral adapter, 9 - memory controller, 10 - buffers of serial port, 11 - parallel port interface, 12 - parallel port registers, 13 - external bus interface, 14 - parallel port output, 16 - serial port output, 17 - internal bus.

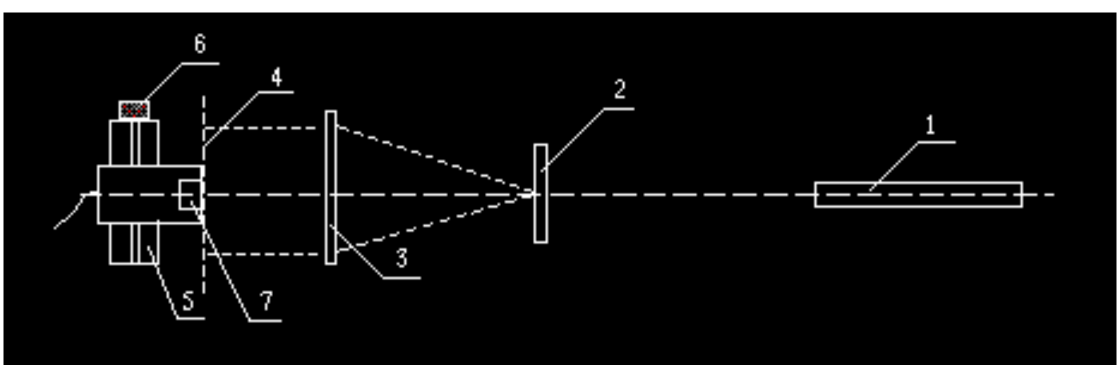

Fig. 2 The function chart of the wave length gauge:

1 - source of radiation, 2 - system of lenses, 3 - interferometer Fabri-Pero, 4 - plain of interference picture, 5 - transport platform, 6 - step driver, 7 - light-sensitive element.