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# THE AUTOMATION UNIT DESTINED TO MODERNIZE THE ATLAS IZOTOPIC MASS SPECTROMETER (AUMMS)

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**Abstract**: A vacuum system protection and automation unit was designed and built up for ATLAS 86 mass spectrometer. This mass spectrometer analyses small variations in the abundance of stable isotopes like $^{13}C$, $^{18}O$, $^{34}S$, and $^{15}N$ with an accuracy of 0.01%. This paper presents a short description of the vacuum system of the mass spectrometer, the components of the vacuum protection and automation unit, and the manner of working of the whole system.

**Key words:** mass spectrometer, vacuum system, micro-controller, automation, and surveillance.

## 1.INTRODUCTION

Mass spectrometric methods are by far the most effective means of measuring isotope abundance. A mass spectrometer separates charged atoms and molecules on the basis of their masses based on their motions in magnetic and/or electric fields. [1]

In principle, a mass spectrometer may be divided into four different parts: the inlet system, the ion source, the mass analyzer, and the ion detector. Inside of these parts must be a high vacuum.[2] Today, the newest mass- spectrometer generation is fully automated and computerized, improving the reproductibility to values better than ±0.02 ‰. Also, it is necessary to run a very large number of samples that is mass spectrometer must work continuously. This is the reason that we have proposed a modernization of the mass spectrometer, and the first step was to design and built up a vacuum system protection and an automation unit [3].

## 2. CONTENTS

The insurance of the high vacuum protection is necessarily so that the isotopic analysis mass spectrometer correctly work and require both: the using of the high performance vacuum pumps and the nonstop working of them. If there aren't assured some conditions during pumps running, they get out of order [4]. For this reason there is of capital importance the existence of a electronic unity destined to keep working the pumps if there only the necessarily conditions are accomplished.

The vacuum system of mass spectrometer is made up by three distinct subsystems: there is one, which assures the vacuum in the magnetic analysis chamber,

the second, which assures the vacuum in the inlet subsystem [5] and the third vacuum control interface who measures and displays vacuum values in different places.

The first subsystem is made up of preliminary vacuum pump, one turbo-pump, air electro-valves and separation electro-valves, two gauges for measuring the preliminary vacuum at the rotary pump input, respectively at the turbo-pump output, and a high vacuum gauge for vacuum measure inside of the chamber analyzer.

The second subsystem is made up of preliminary vacuum pump, one spreading pump, air electro-valves and separation valves, two preliminary gauges and a high vacuum gauge.

The A.U.M.M.S. consist of few parts like:

-the electronic circuitry for vacuum pumps and for electro-valves action,

-the electronic relays for overload protection,

-the vacuum measure circuitry corresponding to the vacuum gouge,

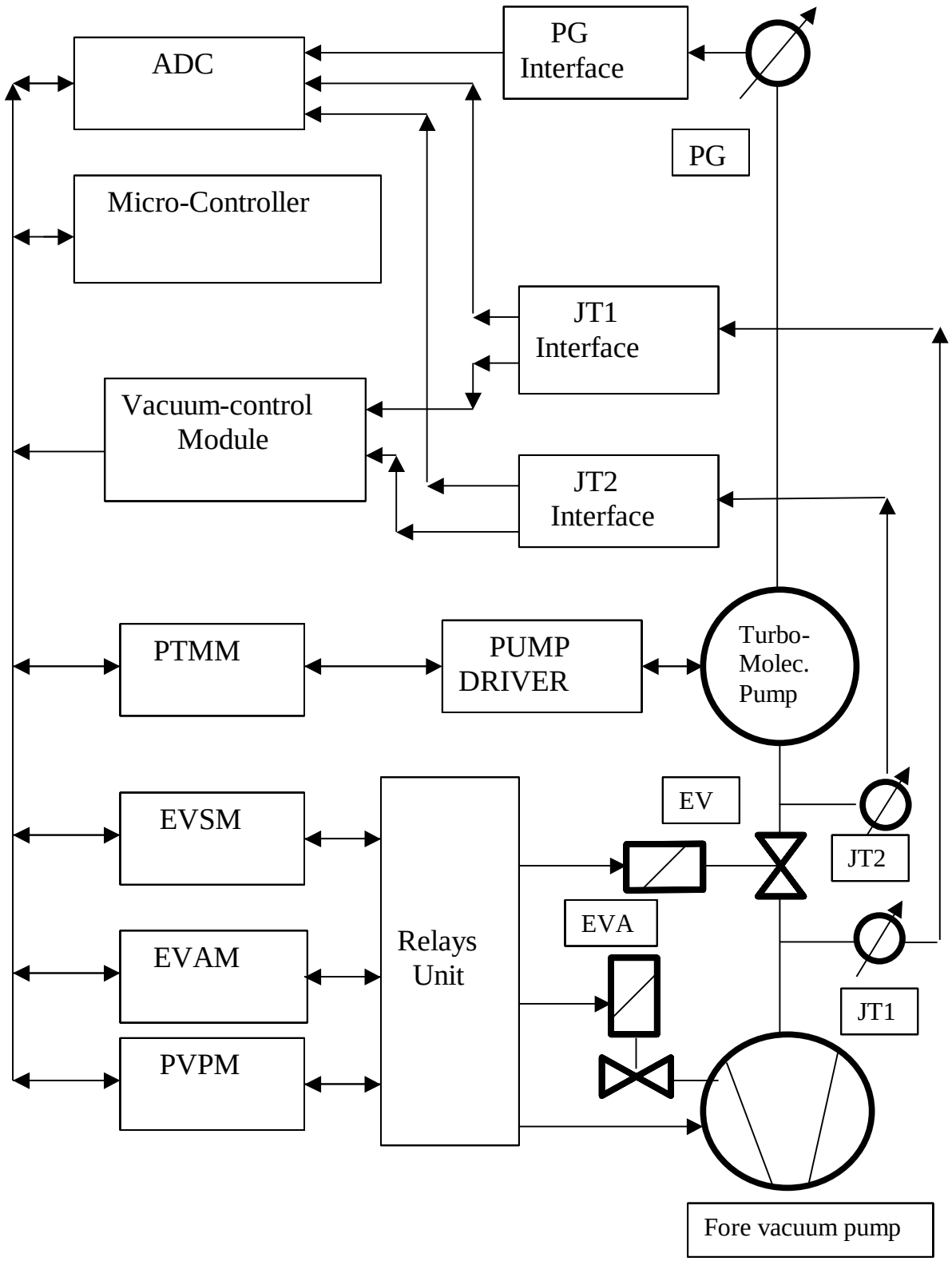
-the logic circuitry which assures pump working conditions check (protection function) and the correct starting, respectively stopping sequences (automation function),

-the part that assure the correct shut down of mass spectrometer in case of accidental net voltage fall (power supply interrupt protection) , and the automatic restarting when the net voltage gets back,

-for the A.U.M.M.S. building we are designed and realized the electronic relays for overload protection as well we are used the CMOS integrated circuits in local protection logic of the the power components (pumps, electro valves, heating resistors).

By means of some dedicated micro-controllers on achieved starting sequences and restarting protocols for the two vacuum systems.

Below there is the block diagram for AUM.


ADC
PG Interface
PG
Micro-Controller
JT1 Interface
Vacuum-control Module
JT2 Interface
PTMM
PUMP DRIVER
Turbo-Molec. Pump
EVSM
EV
JT2
EVA
EVAM
Relays Unit
JT1
PVPM
Fore vacuum pump

The major functions of the unit are accomplished by the following modules:

**1 Vacuum control module**

a) It manages the logical signals from the vacuum gauges and made the command signals in correlation with the other system components.

b) Memorize all the abnormal events.

**2 PVPM**

This module checks and assures the rotary vacuum pump protection at short circuit and overload.

**3 EVSM**

Manages the separation valve during the start, stops and restarts after break-down of the mass spectrometer.

**4 VAM**

This module drives and checks the air electro-valve and memorizes the failure events.

**5 PTMM**

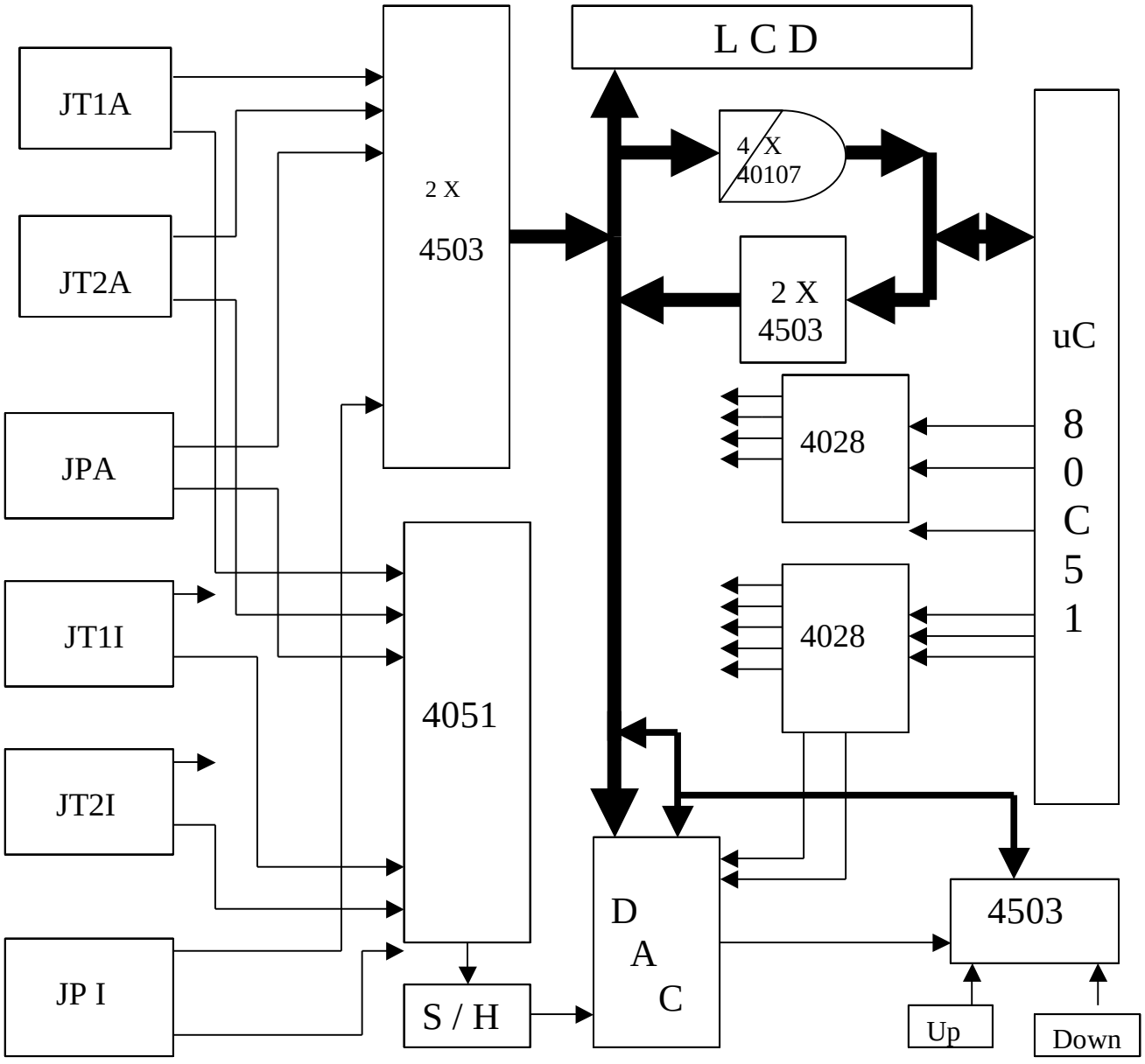
Makes the connection of the micro-controller module and of the turbo-pump unit giving the Start- Stop commands and checking the signals from it.

All of these modules are interconnected with the micro-controller unit by a bus system.

The micro-controller unit manages:

-Starting sequence commands
-Stopping sequence commands
-Acquiring the signals from the vacuum gauges
-Linearise the transfer function of the vacuum gauges
-Digitally displaying for the vacuum system parameters.

Vacuum Control Interface




In the previous block diagram there is shown the principle of design of vacuum gauges module interface. These vacuum gauges monitoring interface accomplish the following charges:

1.Surveillance of the validity state of the vacuum gauges

2.Signal collection from 1 to 8 points of measure by means of a programmable analog switching of channels device.

3. Analogue to Binary Conversion of the vacuum signals by means of a 12 bits.

4.Binary to Decimal Conversion by means of the 8051 Atmel microcontroller assembler language subprogram.

5.Decimal Numbers representing voltage magnitude to Decimal vacuum measure units Conversion, on base of every gauge calibration look up table.

6.Decimal-ASCII Conversion and display on a LCD panel (4 rowws/20 colons) of the required information about general vacuum chain state.

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