DATA ACQUISITION & CONTROL SYSTEM FOR NEUTRON SPECTROMETERS AT THE LLB

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There are 24 neutron spectrometers installed around the ORPHEE research reactor, all equipped with an acquisition and control system known as « **DAFFODIL SYSTEM** ». This system has been developed by the electronic group of the laboratory. Its backbone is the IEEE 488 BUS. Up to 32 peripherals can communicate with the user host computer via this standard communication protocol. The DAFFODIL SYSTEM is composed of a few IEEE 488 devices, which are designed for independent execution of complete functions (see figure 1).

The past two years, three main functions **(positioning**, **counting** and **Position Sensitive Detector acquisition** including **Time Of Flight)** have been particularly developed at the LLB for a maximum integration and simplicity of use. They form the core of the data acquisition equipment for any kind of neutron spectrometer.

For each function, an intelligent IEEE 488 microprocessor board has been designed. These boards constitute the Euro series (**EuroMove**, **EuroScale**r and **EuroPsd**), which are at present installed on the experiments. This triple function subsystem comes in the form of a single (see figure 2) or double Europe crate. It contains the location for the Euro series modules, power supplies for the electronic system as well as for the motors and the peripherals boards for motor control, readout and display of encoded axis and diverse I/O.

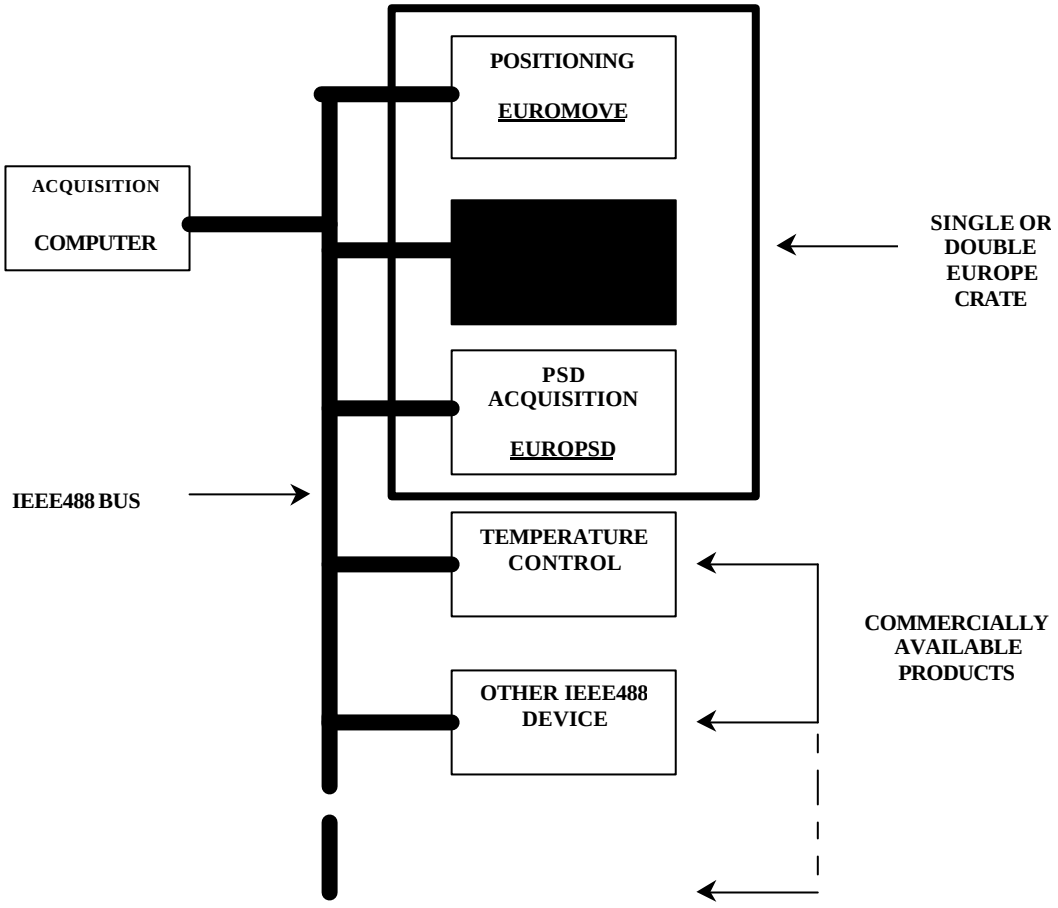

Figure 1. Outline description of the LLB Daffodil system.

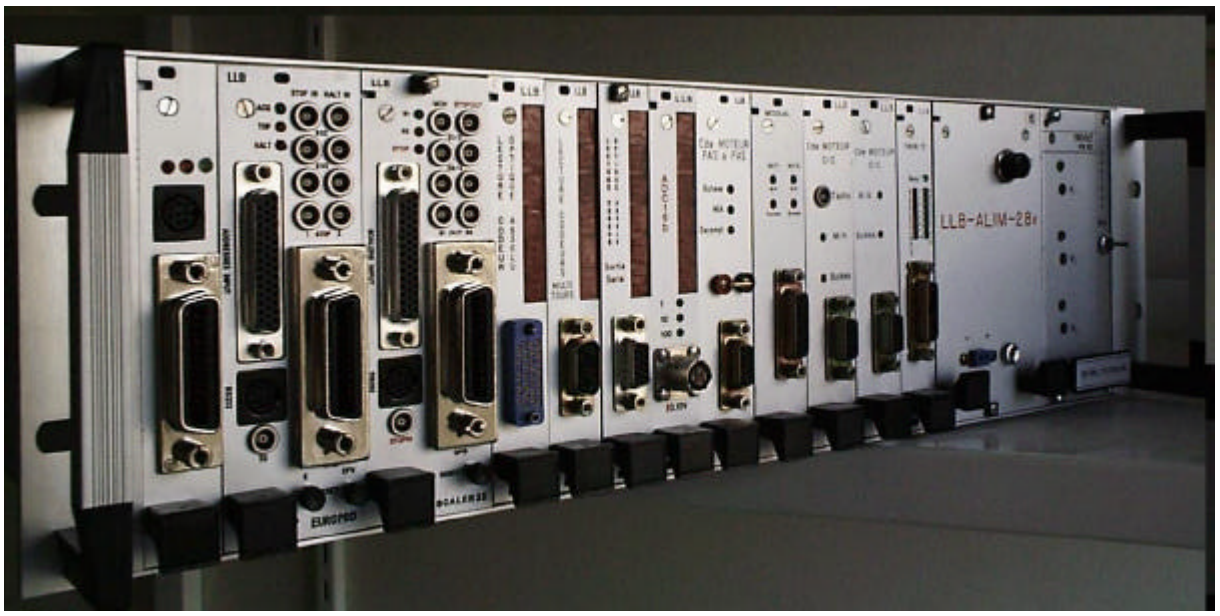

Figure 2. Single Europe crate for the Daffodil System of LLB

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THE EUROMOVE MODULE

The EuroMove module is a positioning controller. It is a single Europe board (100 x 220 mm^2), which can control **up to 10 axis simultaneously** through its own bus. This in-house design bus has been studied to allow on the one hand the mixing of power and logical signals and on the other, to provide a very simple and efficient interface to slave boards (encoder, motor, I/O boards etc.). Since the Europe crate contains the power supplies for the motors, **there is no need for another distinct power crate** nor additional connections.

The main role of the EuroMove module is to drive the motors through the motor boards, while monitoring the actual position of the mechanics via the encoder boards, to a position required by the computer. This module also provides a **real time display of the position** of each of the movements on the front panel of the encoder boards. The calculations are performed on 16 000 000 points, the displays showing 6 digits.

The onboard software embedded in the EuroMove module operates with different methods of positioning for each movement depending on its own encoder, motor and mechanic characteristics. In particular, it provides a **complete functional control of the pneumatic system** required by the « Tanzboden modules ».

Two types of boards, for D.C. and stepping motors as well as encoder boards for optical, magnetic and resistive sensor technologies have been designed. Thus, the user can choose the motorization and position encoding equipment that best fits his particular environment.

THE EUROSCALER MODULE

The EuroScaler module is basically a counting module for discrete detectors and monitors. Designed as a single Europe board, it is stand-alone and needs only the +5V to operate.

The Euroscaler module has an internal timer, a monitor counter and 32 scalers; it therefore can manage **a complete monitor preset or time preset operation on 32 detectors**. Moreover, it provides a **fully automatic acquisition mode for polarized neutrons** including up to 4 phases for polarized neutron analysis. The module outputs logical signals for driving the flippers. The duration for each of the phases and the dead time for the flipping of the magnetic field are programmable.

Input and output triggers for external synchronized systems like a EuroPsd module or another Euroscaler module are also available. For example, if there are more than 32 detectors on the experiment, several Euroscaler modules can be used, one of them will play the role of master and the others the role of slaves via their input triggers.

THE EUROPSD MODULE

For **data acquisition with fast Position Sensitive Detectors** (in particular those based on delay lines or microstrips), and to provide **Time Of Flight operation**, we have designed the **EuroPsd module** (see figure 3), which is stand-alone like the EuroScaler module.

The main function of the EuroPsd module is **histogramming memory**. It accepts a 18 bits to

accommodate a 512x512 cells PSD. Cells of the detector are associated **with 32 bits data counters**. One of the features of this module is the programming, through user friendly commands, of the allocation of the counters via a **routing memory**. This feature has many applications, for example, **converting a rectangular detector into a virtual circular detector**. Non adjacent cells can also be grouped together to form a multiparts « macrocell ».
In the Time Of Flight mode, the delay, the number of time channels (up to 4096) and their **width (200 nsec up to 7 minutes** by steps of 100 nsec) are programmable. Long duration time channels can be used in conjunction with another capability of the EuroPsd module, which is to follow and to distinguish several « frames » in a **kinetic experiment**.
With this EuroPsd module, the **maximum counting rate achievable is 5 MHz** with a null dead time, i.e. an address takes less than 200 nsec to be processed (routing, histogramming and T.O.F).

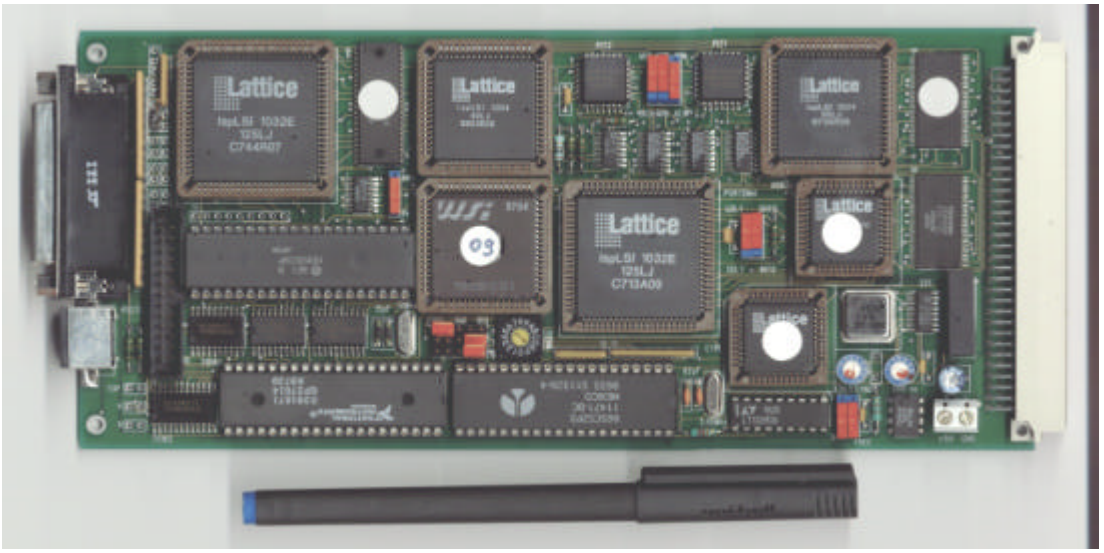

Figure 3. EuroPsd module for data acquisition and Time Of Flight

Several laboratories in the world are equipped with the LLB DAFFODIL system, among them K.F.K.I. (Hungary), I.T.N. (Portugal), Institute of Physics (China), Institute of Nuclear Technology (Greece), and more recently K.A.E.R.I. (Korea) in association with the CILAS company.