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GPIB CONTROLLED MÖSSBAUER SPECTROMETER - MsAa-1[1]

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A Mössbauer spectrometer controller and data acquisition unit have been developed and tested as well as accompanying software packages. A unit itself can be mounted in a three module CAMAC or NIM block. It communicates with the computer of the IBM PC/AT family via a standard transparent General Purpose Interface Bus (GPIB/IEC-625). The unit is autonomous as far as the data collection and transducer operation are concerned.

There is still a need for a modern multi-purpose Mössbauer controller/data acquisition unit in our feeling. Numerous such units have been built successfully and reported in the literature [1], however almost all of them were somewhat specialized or not flexible enough. The above mentioned unit has to perform the following functions: 1) to generate a reference signal for a transducer, 2) to collect TTL pulses in the synchroneous multi-scaler mode in two independent banks at least without losses and delays, 3) to be able to accept data from a separate analog to digital converter (ADC) in order to set a single channel analyzer window and to estimate background under the Mössbauer γ-ray line, 4) to set a single auxiliary parameter on-line at least, e.g., a sample temperature and 5) to sense a single-bit status of the experiment at least. A unit has to communicate with the host computer via the fast multi-user link and it has to be as independent from the host as practical. It seems that the MsAa-1 unit and accompanying software meet these goals.

The unit is mounted in a 3-module CAMAC or NIM block (see Fig. 1). The bin is used to provide power only. Functions of the unit are quite flexible due to the on-board processor and 64 kbytes of the memory. Namely, it can perform the following functions presently: 1) to generate the analog reference signal for a transducer in the range $\pm$ 10 V,

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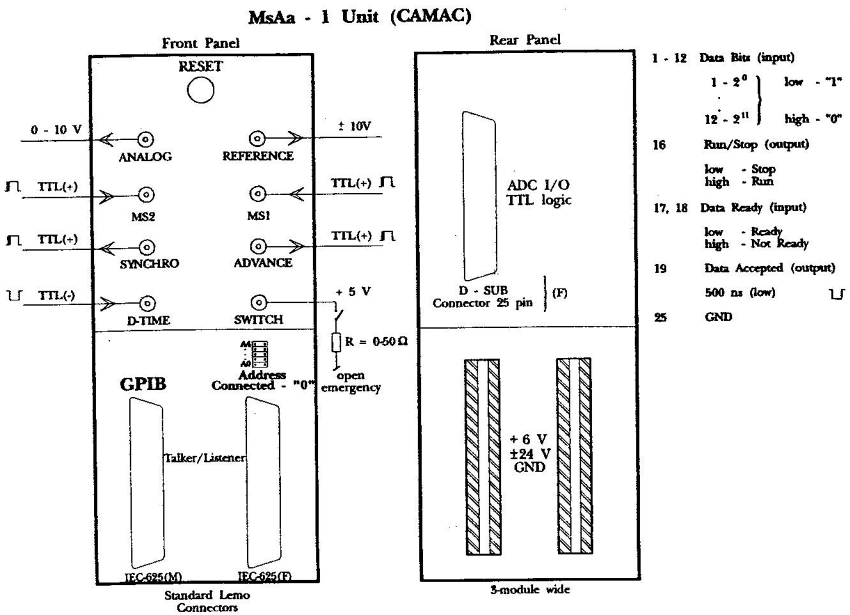

Fig. 1. Schematic layout of the signals accepted by and derived from the MsAa-1 unit.

the latter being based on the down-loadable reference file having 8192 channels per cycle and 12-bit precision per full voltage range. A cycling frequency can be set to any value from the range $[(2 \times 1.0^6)/8192]/N$ [Hz], where $N = 2, 3, \ldots, 255$. 2) To generate a quasi DC analog signal in the range 0-10 V with the 8-bit precision, the latter being controllable directly via the GPIB (General Purpose Interface Bus) link. The analog signal can be used to control (vary) any auxiliary parameter like sample temperature or magnetizing field. 3) To control status of the external emergency switch. The switch signal is used to stop multi-scaler data acquisition in the emergency situations (at the end of cycle). All these functions are independent of the data acquisition functions. There are two data acquisition modes: 1) a multi-scaler (MS) having two completely independent memory banks of 256, 512, 1024, 2048 or 4096 channels each (the number of channels is the same for both banks). Multi-scaler input buffers can handle all pulses separated by more than 125 ns regardless of the bank chosen at any combination of the number of channels and repetition frequency. Capacity of each data channel equals 32 bits (more than 4 Gcounts). 2) An amplitude analyzer (up to 4096 channels of 32 bits) operating in any mode (direct, coincidence or anti-coincidence) provided an ADC unit is included, separately. A dead-time counter is built-in. A total dead-time equals ADC dead-time increased by 6 μs needed to store the data at most. The unit is able to drive an external memory as signals SYNCHRO (delayed about 1 μs) and CHANNEL

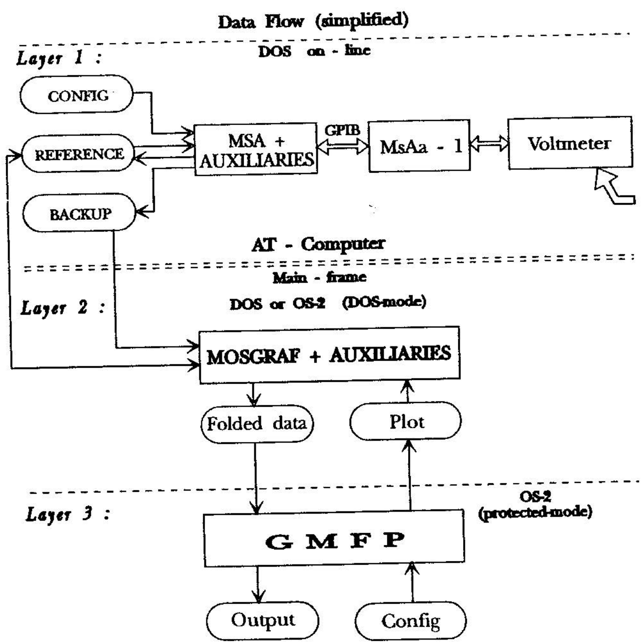

Fig. 2. General layout of the data flow in the software system. Voltmeter stands for any device used to monitor external parameters like temperature or external magnetic field.

ADVANCE are available on the front panel. It communicates with the host computer via the General Purpose Interface Bus (GPIB) link. A GPIB address of the unit can be set manually on the front panel. It has to be noted, that data acquisition modes are exclusive at the moment and that the reference signal is driven at the highest repetition frequency in the amplitude analyzer mode.

There are several "layers" of software. The first "layer" written under the C++ language is responsible for the on-line control of the experiment and it operates under the DOS system and requires a GPIB card and driver to be residently active. This program is needed to occupy memory for: 1) changing or initializing the experimental setup, 2) to watch data accumulation, 3) to perform data or reference backup and 4) to set a new value for a quasi DC signal. Otherwise, the MsAa-1 unit is autonomous.

A second "layer" is designed to be executed on a more powerful computer under either DOS or OS-2 multi-task system (DOS-mode) and it is responsible for: 1) reference generation, 2) background calculation, 3) spectrometer calibration and 4) presentation of the final results. These programs (MOSGRAF) have been written under the Fortran-77.

A third "layer" is designed to process Mössbauer data from the "first principles" and it has to be executed in the multi-task environment in the protected mode (see

Fig. 2). The second and third "layers" are based on the previously developed MOSSLIB programs [2], however MOSGRAF has been integrated into almost a single system with the extensive use of graphical aids.

The minimum configuration of the computer driving an experiment has to be as follows: IBM PC/AT(XT) compatible board having 1 Mb (640 kb) memory at least, a graphical card having resolution not smaller than the Hercules standard, HD divided into three partitions and having a total capacity not less than 20 Mb, some floppy disk drive(s), a PC-3key mouse and a GPIB card (IEC-625). Two COM ports are required in order to drive mouse and to communicate with the more powerful data processing system. The computer has to be operated under the DOS operating system (all versions higher or equal 3.3). A mouse and GPIB drivers have to be installed as well as a communication software with the "main-frame".

The "main-frame" computer has to be of the 386DX class at least, equipped with the fast coprocessor and cache memory. In order to exploit fully a multi-task capability, it is required to have 16 Mb of the total memory. A large capacity HD is required as well. MOSGRAF requires a graphical card being capable to emulate the Hercules standard and a PC-3key mouse to be active. Printed outputs (from both computers) are designed to be compatible with the standard 8-pin dot printer 10" wide at least. Final plots can be printed at 300 x 300 dpi resolution on a standard laser printer having 2 Mb of memory at least. The computer has to be operated under the OS-2 multi-task system (all versions higher or equal 1.10), the latter being set for a protected and unprotected modes to be accessible. All graphical modes of the MOSGRAF system are executed under the Halo Professional system for Fortran by Media Cybernetics.

References

[1] M.Benedetti, D.R.Fernandez: *Rev. Sci. Instrum.* **52** (1981), 1406; N.Bhattacharjee, V.A.Pethe, S.Kumar, P.K.Mukherjee, M.K.Sanyal K.D.Sabnis: *Proc. Indian Natl. Sci. Acad. Part A Special 934* (1982), ;
G.Faigel, P.E. Haustein, D.P.Siddons: *Nucl. Instr. Methods Phys. Res.* **B17** (363), 1986;
F.A.Theopold, E.Gerdau, R.Hollatz, H.Riege, R.Rüffer, R. van Staa: *Hyperfine Interact.* **29** (1986), 1555;
S.Grogan, J.Thornhill: *Nucl. Instr. Methods Phys. Res.* **A256** (1987), 525;
E.C.Pitzen, J.Jing, U.Gonser: *Nucl. Instr. Methods Phys. Res.* **B31** (1988), 487;
F.Cavatorta, A.Deriu, C.Schiaretti: *Hyperfine Interact.* **46** (1989), 715;
F.W.D.Woodhams, S.M.Reeder: *Meas. Sci. Technol.* **2** (1991), 217;

[2] K.Ruebenbauer, T.Birchall: *Hyperfine Interact.* **7** (1979), 125;