

IBM PC-BASED MULTIPURPOSE DATA-ACQUISITION SYSTEM FOR THERMAL ANALYSIS

J. Házi, L. Pöpl, Ö. Pintér and L. Daruházi

L. EÖTVÖS UNIVERSITY, BUDAPEST, 112 PF. 32, H-1518, HUNGARY

A multipurpose data-acquisition system based on IBM PC or compatible computers has been developed for analog thermoanalytical equipment (especially for the Mettler TA 1 and TA 2 and Derivatographs). The system is versatile, easily tailored to specific requirements, and permits multitask operation, i. e. the collection of data from current experiments and the evaluation of results from previous experiments simultaneously.

Modern thermal analysis instruments are microcomputer-controlled analysers that control the TA modules and collect, process, store and report data. However, there are still numerous instruments in good condition without the possibility of the greater data manipulation capabilities provided by a computer. We set out to solve this question and have assembled a multipurpose data-acquisition system based on IBM PC or compatible computers. This system is versatile, easily tailored to specific requirements and, applied to analog TA instruments, can in most cases control the heating programs, data-processing and evaluation.

The system (Fig. 1) consists of module units. The temperature-regulating circuit controlled by computer is used as a phase-splitting thyristor power controller and is directly connected to the BUS of the computer. The phase angle, and thus the heating power output, is controlled by a software code (PID) provided by the computer as a function of the furnace temperature. The operation of the system is independent of the mains frequency. The output power of the temperature-regulating unit is at most 2.2 kW.

The data-acquisition system consists of an at least two-channel, thermally stabilized pre-amplifier scanner with separate channels for inert or sample temperature, mass and DTA signals. The gain can be set by software for T and DTA channels. The DTG signal is calculated by the computer during the measurement.

*John Wiley & Sons, Limited, Chichester
Akadémiai Kiadó, Budapest*

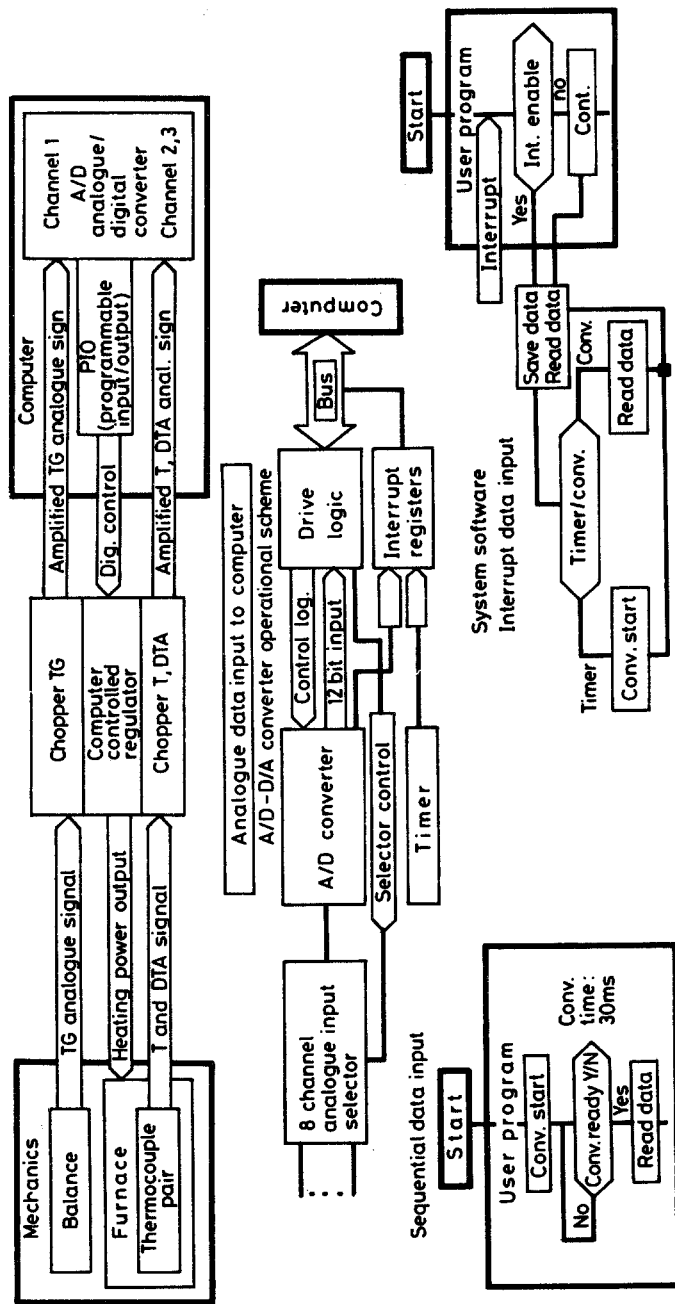


Fig. 1 Computer controlled thermoanalytical system

A 12-bit A/D converter built into the computer operates under interrupt control data-input, controlled by system software permitting multitask operation, i.e. the collection of data from current experiments and the evaluation of data from previous experiments. A clock situated on the A/D converter panel generates an interruption every 100 ms, which sets the conversion in action at the preselected channel. On the start signal, the routine returns to the user program until the conversion end signal arrives (≈ 30 ms). In this way, the long conversion time does not load the running time appreciably and the timing of sampling is always accurate, independently of the type of computer.

General features of the program are the window-style menu operation, "point and shoot" file selection, intelligent menu structure, data stored in condensed form and the parameter header file structure.

Before on experiment, the parameter file can be filled, which holds all the information needed (type of furnace (if more than one), thermocouple, crucible, gas, sample holder, sensitivity of TG, DTA, etc.). The next step is to give the heating program parameters and the manner of data collection. There are three data-collection possibilities: constant time interval, constant temperature interval, and if the change in one of the signals is higher than a given limit. All these parameters are stored together with the measured data.

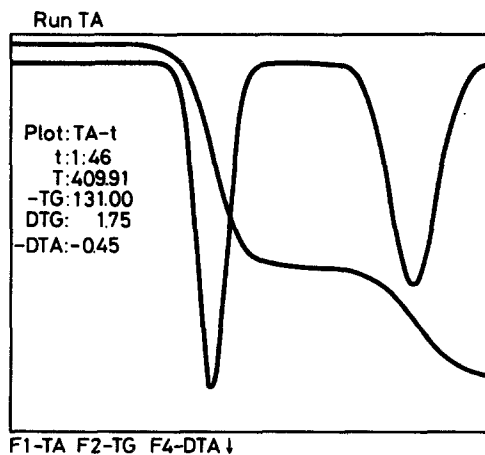


Fig. 2 Data points and curves obtained by the system

After the start of an experiment, the data points and curves are displayed as can be seen in Fig. 2. As mentioned earlier, the display operation can be switched off and it is possible to evaluate the results of previous experiments and, after finishing, to go back following the run. At the end of the experi-

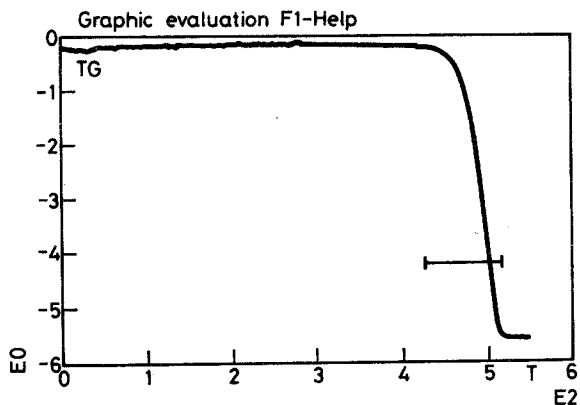


Fig. 3 Graphic results of automatic TG evaluation

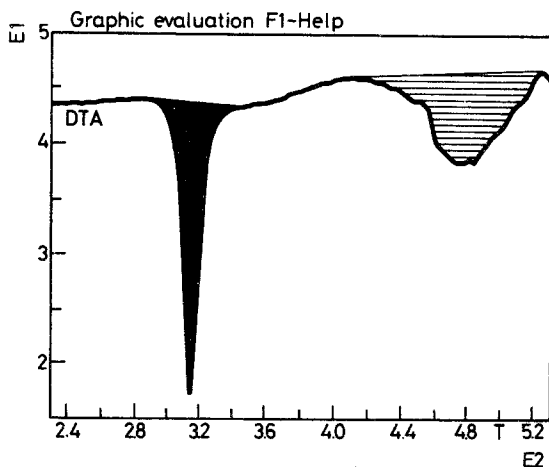


Fig. 4 Graphic results of automatic DTA evaluation

ment, the computer stores the data on disc automatically. The methods of data collection and compression allow a minimal amount of data storage without loss of detail.

Once the data have been collected, the results of the run can be evaluated and reported. In the course of automatic evaluation, the characteristic points, sections and peaks of the curves are calculated according to given parameters and the results are plotted on the screen. Figures 3 and 4 show the graphic results of automatic TG and DTA evaluation, respectively. If the user does not agree with the automatic calculation, corrections can be made by making use of cursors in graphic mode operation. The results of calculations can be printed on the screen or a hard copy can be obtained. The other data-processing facilities are as follows: smoothing of the curves, derivation, increase, decrease, base-line correction, subtraction of curves, calculation of peak area, and conversion of change in weight into percentage of sample weight.

Conclusion

A versatile system has been developed for analog TA equipment (especially for Mettler TA 1 and TA 2, and Derivatographs). It saves a great deal of time and allows a more detailed and accurate analysis of data than was possible previously. With minor modifications, it could be used for other instruments.

Zusammenfassung — Basierend auf IBM PC oder kompatiblen Computern wurde ein Mehrzweck-Datenerfassungssystem für analoge thermoanalytische Geräte (besonders für Mettler TA1 und TA2 und Derivatographen) entwickelt. Das System ist vielseitig, kann spezifischen Anforderungen leicht angepaßt werden und erlaubt den Foreground-Background-Betrieb, d.h. es können gleichzeitig Daten eines laufenden Experimentes erfaßt und Daten früherer Experimente ausgewertet werden.