CAMAC bulletin

A publication
of the
ESONE Committee

ISSUE No. 11
November 1974

WHAT IS CAMAC?

CAMAC is the designation of rules for the design and use of modular electronic data-handling equipment. The rules offer a standard scheme for interfacing computers to data transducers and actuators in on-line systems. The aim is to encourage common practice and compatibility between products (both hardware and software) from different sources.

CAMAC was originally defined by the ESONE Committee, a multi-national inter-laboratory organisation of data-processing experts from nuclear institutes. However, CAMAC is concerned with data-handling problems that are not specific to nuclear research and is being applied already in many other fields. Working groups of the ESONE Committee are considering further hardware and software aspects of systems for measurement and control, and maintain close liaison with similar working groups of the USAEC-NIM Committee and also with the International Electrotechnical Commission.

CAMAC is a non-proprietary specification which can be adopted and used free of charge by any organisation and without any form of permission, registration or licence action.

The CAMAC Bulletin, a publication of the ESONE Committee, disseminates information on CAMAC activities, commercially available equipment, applications, extensions and explanations of the rules.

PRINCIPAL CONTENTS OF PREVIOUS CAMAC BULLETIN ISSUES

CONTRIBUTIONS TO FUTURE ISSUES*

of the Bulletin should be sent to the following members of the Editorial Working Group:

Application Notes, Development Activities, Laboratory Reviews and Software: Dr. W. Attwenger, SGAE, A-1082 Wien VIII, Lenaugasse 10, Austria.

New Products and Manufacturer News: Dr. H. Meyer, CBNM EURATOM, Steenweg naar Retie, B-2440 Geel, Belgium.

Product Guide: Mr. O. Ph. Nicolaysen, N.P. Division, CERN, CH-1211 Geneva 23, Switzerland.

Bibliography and any ESONE News Items, etc.: Dr. W. Becker, CRC EURATOM, I-21020 Ispra (Varese), Italy.

* *DEADLINES FOR SUBMISSION* (issue No. 13)
For articles and New Products: 25.2.1975
For Short News and Software Products: 29.4.1975
For Product Guide: 20.5.1975

On the cover: Landscape at Jülich, Germany. The center of the picture shows KFA Jülich where in October 1972 the ESONE Annual General Assembly has taken place.
(Luftaufnahme Aero-Lux. — Frei Reg. Präs. Darust Nr. 322/74).

CAMAC
bulletin

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CONTENTS OF THIS ISSUE

HIGHLIGHTS OF ESONE ANNUAL GENERAL ASSEMBLY

WARSAW, SEPTEMBER 1974

The ESONE Annual General Assembly was held during 18th-20th September in the Forum Hotel, Warsaw, Poland. The international significance for CAMAC of this first meeting of the ESONE Committee in Eastern Europe was noted by H. Meyer in his opening review of ESONE activities during his year of office as Chairman. The year had been notable for the formation of CAMAC Associations and the enthusiasm shown for these by both Users and Suppliers of CAMAC equipment and systems. The outstanding and continued co-operation between the NIM Committee in the U.S.A. and the ESONE Committee in Europe has resulted in publication of the Serial Highway Description and agreement on the text of the Intermediate Language IML. Further to this, the foundation had been laid for closer cooperation between laboratories in East and West Europe on the CAMAC standard and its applications and the task of obtaining IEC recommendations, based on the CAMAC standard, had made good progress.

The Chairman of the Dataway Working Group reported the publication of the Description of the Serial Highway and Amendments to it. The final specification of the Serial Highway would have the same basis as the description.

Standardisation of DC voltage and current signals, which should be used in industrial or medical systems, was a topic reported by the Chairman of the Analogue Working Group. Three classes of signal receivers were under discussion, one single-ended and two others floating with common-mode voltages of ± 10 volts or ± 400 volts.

The Mechanical Working Group was discussing Auxiliary Connectors for industrial or medical use but there was no real consensus of opinion, as yet, about how to solve the problem.

The Annual General Assembly recommended that the CAMAC Bulletin might be restructured so as to separate items related to ESONE Committee activities and the promotion of CAMAC applications and thereby, the Bulletin could act as a publication for both the ESONE Committee and the European CAMAC Association. Following the very successful 1st CAMAC Symposium in Luxembourg, during December 1973, it was announced that the 2nd CAMAC Symposium would be held in Brussels, October 14-16, 1975 and a Symposium Organisation Committee has started work under the chairmanship of P. Christensen.

The achievement of the Software Working Group in reaching an agreed text for IML, in co-operation with the NIM Committee, was recognised by the Assembly's acceptance of IML for publication. Probably, IML will have a specification like EUR 4100 and will be one standard language for CAMAC. Although it may not solve all problems, it is now an available language. A discussion on the use of BASIC as a host language in test applications revealed that there are some problems with the different interpretations in different implementations, therefore the Working Group should try to rationalise this situation for implementations in CAMAC. This rationalisation should include implementation of interrupts with the aid of preprocessors. The fundamental interest in BASIC arises from the fact that untrained personnel currently use BASIC and therefore will be able to use CAMAC very quickly. At the end of the Software discussion, mention was made of the collaboration of several ESONE Committee members with the European Purdue Workshop.

A review of the use of CAMAC in Europe revealed considerable expansion of the activities of both Organisations and Companies since the last Annual Assembly. This had highlighted the need for co-operation between Users and Suppliers in many diverse areas of application and for this reason the European CAMAC Association (ECA) had been founded. The Association has already Working Groups devoted to specific needs of industrial and medical users.

B. Macefield from Oxford University, England, became the ESONE Chairman for 74/75. B. Macefield considered and discussed in his outlook possible future activities of the Committee and recommended that work should continue with all speed to complete the specifications of the Serial Highway and of IML. New work should go into the computer network field which becomes daily more and more relevant. He believed that the relationship between hardware and software developments would be closer in the future than ever before and the time would come when, for example, the message structure specification would be of more interest than the hardware interface description, since LSI semiconductor developments would change the scenery from hardwired logic to software-controlled microprocessors.

The ESONE Committee Membership was expanded to include new Members from Dubna, USSR, Helsinki, Finland and Berlin, German Dem. Rep.

Because of the resignation of the Secretary from CRC, Ispra, Dr. H. Meyer provisionally accepted the request for CBNM Geel to provide the Secretariat in the future.

Seven manufacturers exhibited CAMAC products and systems: Borer, Schlumberger, Emihus, Nuclear Enterprises and Ortec from West Europe with their well known and diversified products, Polon from East Europe with many new modules for application in the nuclear field and Metrimpex, Budapest, who offered a CAMAC system for industrial and medical use.

At the end of the Assembly, R. Trechciński and his staff were warmly thanked for their hospitality and the perfect organisation of the Meeting. An invitation for the next Annual Assembly came from AEC Risø, Denmark which was accepted.

APPLICATION NOTES

1

A COMPUTERISED AIR POLLUTION MONITORING SYSTEM IN BAVARIA

by

J. Landbrecht

Bayer. Landesamt für Umweltschutz, Munich, Germany

Received 25th June 1974

SUMMARY A multi-component air pollution monitoring system is being installed in Bavaria. CAMAC equipment controlled by computers of the PDP-11 family is used extensively for measurement, data acquisition and teleprocessing in the many widely-dispersed measurement stations and in the central station.

INTRODUCTION

The air pollution monitoring network in Bavaria will represent an important step in controlling the air quality in Bavaria, and has become necessary following the rapid development of this part of the Federal Republic from an agricultural into a modern industrialized state with considerable concentrations of population and industry.

Experience with previous small environment-monitoring systems, together with advances in data-transmission and teleprocessing techniques, the decreasing price of computers, and the large number of measurement stations that are now necessary and the increasing number of pollution parameters to be monitored, all led to a completely new kind of automatic, multi-component air-pollution monitoring system (see Fig. 1). Several years of experience in protecting the environment, especially in air-pollution control, showed that this system should be able to perform or permit the following tasks:

- Intensification of air-pollution monitoring, by continuous and long-term measurements of parameters such as pollutants and meteorological factors;

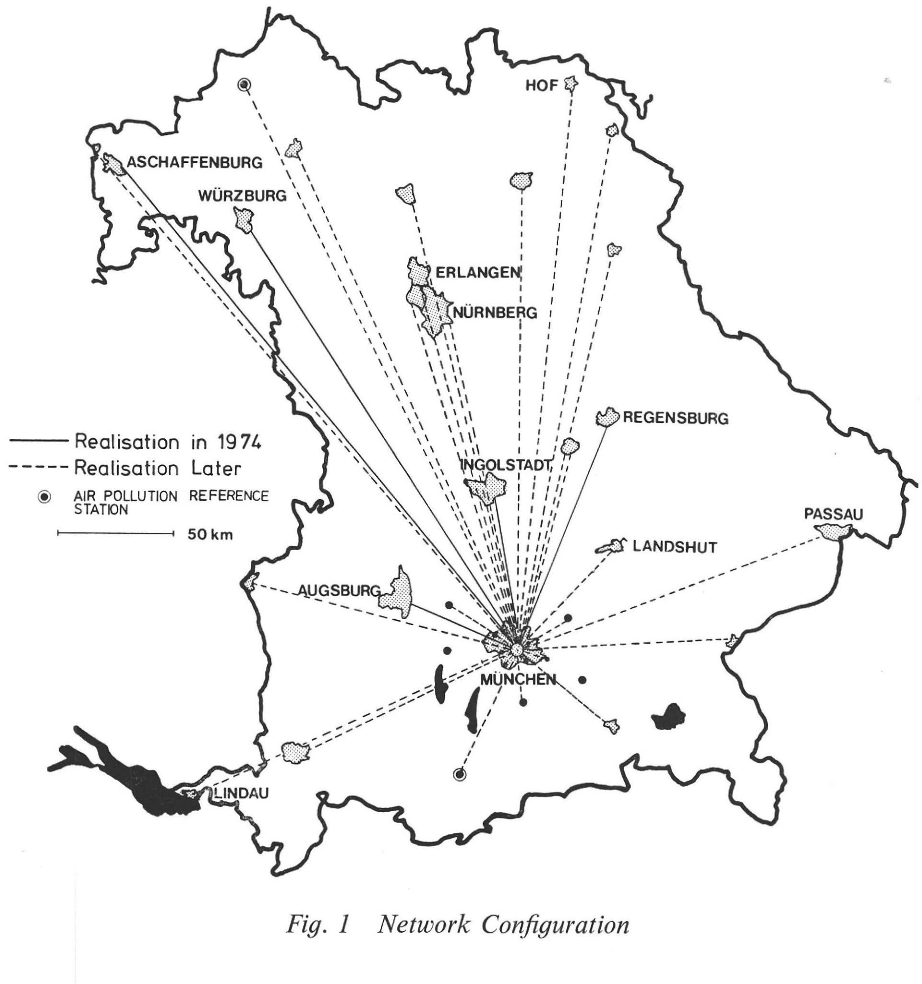

Fig. 1 Network Configuration

- Early information about the formation of smog;
- Notification and observation of dangerous situations of air-pollution;
- Derivation of emission data for establishing and updating anti-emission measures, and for purposes of regional planning;
- Checking the effectiveness of local and regional anti-pollution activities;

- Scientific investigation of the problem of pollution transmission.

The system, in its final form, will comprise eighty measurement stations situated in Bavaria's areas of urban-industrial concentration, and a central station located in Munich. The total cost of the system will be in the region of five million dollars. The first stage of construction—which will be completed by August 1974—provides for the installation of fourteen measurement stations. The project is being carried out by the Bavarian state department for environmental protection, in Munich.

NETWORK CONFIGURATION

The selection of the network configuration and hardware was made primarily with a view to achieving low operating costs, high reliability, long intervals for maintenance, and capability of expanding the system for the measurement of other parameters, for example radiation or the quality of water. An automatic on-line measurement system presented itself as the best solution. The links between the measurement stations and the central station cannot use fixed data-transmission lines because of the very high rental fees in Germany and the lengths of the links, which are nearly 500 km (Fig. 1). Reasons of cost, alone, therefore eliminated configurations based on privately leased lines.

Investigations then showed that use of the public-subscriber telephone network, with its high transmission quality, would have lower rentals for data-transmission, at the same investment costs.

This meant that the entire system is quite new in comparison to previous measuring systems of this kind for environmental monitoring. Instead of continuous transmission of measured data and function checks over fixed lines using frequency-division or time-division multiplex for instance, this is a system whereby data are stored at the measurement stations until they are automatically requested by the network's central station. The use of a mini-computer for acquisition, pre-processing and storage of data in the intervals between data requests is an evident solution for this application.

A further characteristic of this network was the coupling of the mini-computers in the measurement stations to a computer in the central station (see Fig. 2) with particularly useful capabilities for remote loading and testing of computer software in the measurement stations and for fault diagnosis throughout the system.

The outlying measurement stations are controlled by the computer in the network's central station and selected by the automatic dialing unit there. Modems for 1200 bits per second (D1200S) and with automatic answering sets (AAE) are provided. Thus the stations can send data in digital form to the central station or receive control commands from the central station. Automatic calling of the measurement station occurs every eight hours if the air-quality situation is good. If conditions dete-

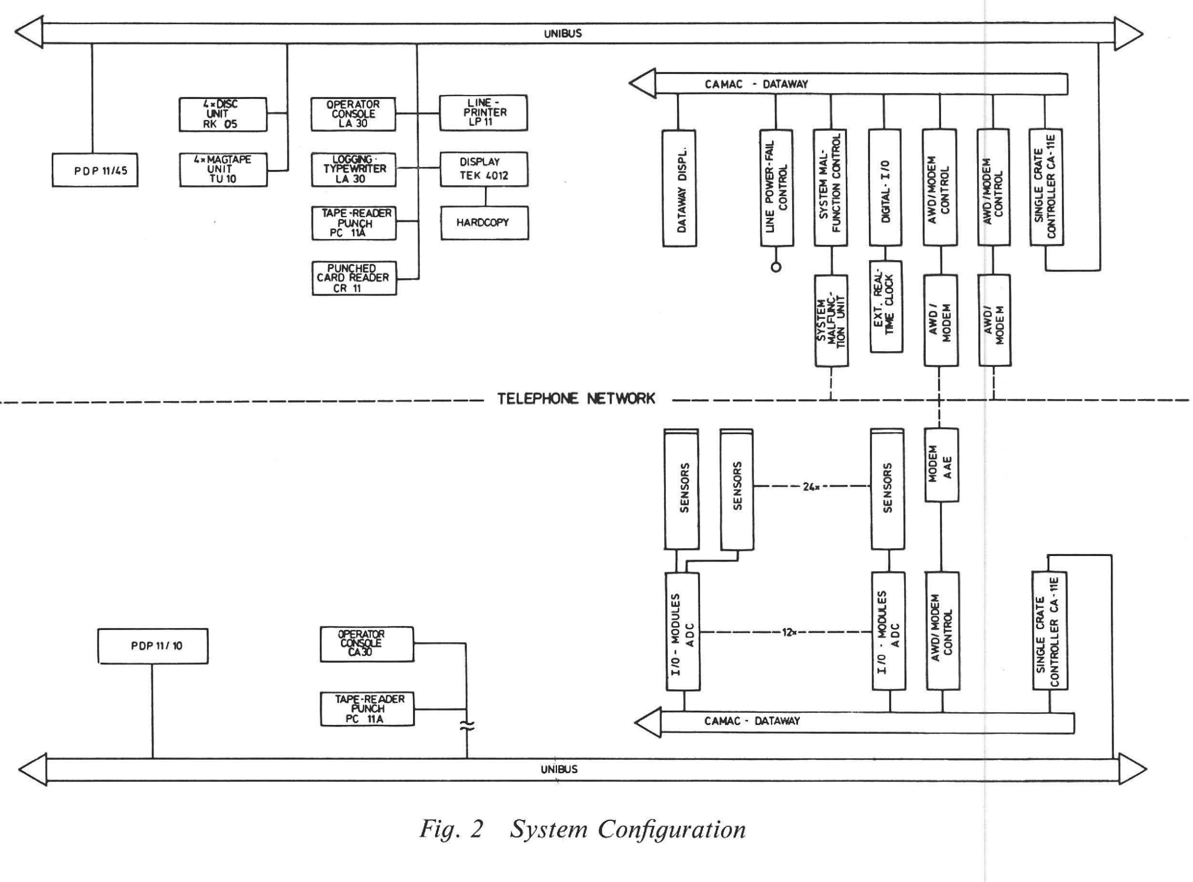

Fig. 2 System Configuration

riorate the cycle is automatically shortened by software control or altered at the discretion of the operator.

As the first stage in setting up the network, each of the fourteen measurement stations must be completely self-sufficient for remote-control purposes. During later expansion of the system, the intention is to interconnect to these stations additional measurement stations which are located within the same local telephone exchange network, in order to economize on computers and modems. One computer-equipped measurement station in each area of operations will thus assume the role of a central substation, and the non-intelligent measurement stations connected to it will deliver measured data on-line. A new data transmission system for this application is under development now.

Measurement Station

The measurement stations are all to be located in representative centers of urban-industrial concentration.

Each measurement station is accommodated in an insulated, double-walled aluminium housing.

It contains the sensor system, two 19-inch cabinet racks for measuring instruments and another for electronic functions and data-processing equipment.

There is a large selection of measuring instruments on the market for monitoring air-pollution parameters and sampling meteorological factors. Many sensors, however, did not fully comply with the exacting requirements for remote-control capability. Suitable instrumentation was found for measuring sulphur-dioxide, carbon-monoxide, hydrocarbons, hydrogen sulphide and dust, plus the meteorological parameters wind direction and velocity, air temperature, humidity, atmospheric pressure, precipitation and solar radiation. Suitable measuring instrumentation is still being sought for other parameters, such as nitrogen oxides, ozone and hydrogen fluoride.

In principle up to 24 sensors for any parameters can be installed in each measurement station, although initially a maximum of twelve channels will be functioning. However, it is very likely that more measuring instruments will be put into operation, for such parameters as radiation, noise, water pollution and for research purposes in biometeorology.

The measuring instruments are sampled every minutes, and the meteorological sensors every 5 seconds. The values obtained in this manner are formed into half-hour mean values, with their variance, in the computer and are stored until requested by the central station. These half-hour mean values are the fundamental data for all other studies. The averaging cycle can easily be reduced to ten minutes by software. The analog output of every instrument, generally as a current of 0 to 20 mA, their digital inputs for controlling zero-point calibration, and the digital outputs for status-check, are interfaced by newly developed CAMAC modules to the I/O-modules with an 8-bit ADC (DO200-1411) and then transferred by a single crate controller (CA-11E) to the PDP 11/05. The advantages of CAMAC in this data acquisition system, because of its modularity and the fact that one is quite independent in one's choice of supplies in future system modifications, also recommended its use for controlling the modems D1200S and the automatic dialing unit by the modem interface with auto-dial option DO200-2911. This is perhaps one of the first applications where CAMAC has been used to such a considerable extent outside the nuclear field.

Central Station of the Network

In the measurement stations the data are preprocessed and stored, and the various functions of the measuring instruments are controlled and checked. The main tasks of the central station, equipped with a larger computer system are as follows:

- Automatic calling of all measurement stations and requesting of data;
- Control and monitoring of the functions of the complete measurement network, automatically or by operator intervention;
- Automatic readout of data on malfunctioning of the system or its components;
- Automatic announcement of the failure of important system components by telephone;
- Data readout showing the air-pollution situation and indication of pollution concentrations referred to time and correlated with meteorological data for periods of up to four weeks;
- Smog warnings by telephone;
- Documentation of all data for further processing;
- Composition of statistics on failures of measuring instruments;
- Keeping track of dates when maintenance is due at the measurement stations;
- Generation of the mainline programs for the satellite computers.

These tasks not only call for efficient hardware, they also require appropriate basic software, particularly for real-time applications, and for these reasons a PDP 11/45 and the real-time operating system RSX-11 D from Digital Equipment were chosen. It is worth noting that a PDP 11/40 would have been sufficient for these tasks, but a PDP 11/45 was selected because, later on, laboratory instruments such as mass and X-ray spectrometers are to be linked to the system.

In addition to extensive peripherals, including various possibilities for storage on magnetic tape and disk units, the central station, like the satellite measurement stations, is characterized by the use of CAMAC for all process electronics. The modem control in the central station includes control of the automatic dialling unit.

SYSTEM SOFTWARE

The tasks, functions and characteristics of the system software have already been briefly outlined, and are summarised in Table I. The user functions which can be initiated from the central station are shown in Table II. These are either automatically or manually triggered functions for the readout

Tabel I Software Structure

CENTRAL STATION:

Software for printouts and software communication
— Function control of central station
— Teleprocessing software
— Software for computer dialog
— Data processing software
— Data storage

MEASUREMENT STATION:

Software control matrix
— Function control of measurement station
— Teleprocessing software
— Software modules for sensor function control
— Data processing software
— Data storage software

Table II System Dialog Functions

1. SYSTEM PRINTOUTS

— Printout of data for last 8 hours
— Printout of data for last day
— List of sensor in measurement stations
— List of sensor parameters
— List of measurement stations

2. SYSTEM FUNCTION CONTROL

— Data request
— Time synchronisation
— Sensor function control
— Single values request

3. SYSTEM PARAMETER UPDATING

— Sensor parameter updating
— Measurement station parameter updating
— Maximum concentration values
— K-value

4. DISPLAY FUNCTIONS

— Actual mean-values (1/2 hr)
— 1 min — data
— Plot of mean-values (1/2 hr)
— Plot of daily mean values

of data, for the various control aspects of the system, for changing the system parameters and for display readouts. In addition to its high technical standard, therefore, the system is also configured to ensure a high degree of practicality for the user, i.e. those working on pollution control.

CONCLUSION

The air-pollution monitoring system in Bavaria will, if everything continues to run as smoothly as it has till now, become operative around August of 1974. This will provide a considerably better foundation for the introduction of effective anti-air-pollution steps, and programs for conservation of the environment. It will also provide warnings of dangerous instances of pollution early enough for counter-measures to be taken.

The use of what is largely standardized hardware in CAMAC and problem-oriented programming languages have led to a flexible system, which can be expanded as required, and also permit communication of data to interested institutions beyond the borders of the state of Bavaria.

REFERENCES

1. Vogl, J., Das lufthygienische Landesüberwachungssystem Bayerns; *Amtsblatt des Bayerischen Staatsministeriums für Landesentwicklung und Umweltfragen*, Nr. 10/197.
2. Hangele, J., Auslegung und Kostenoptimierung von Leitungsnetzen für die Datenfernübertragung; *Computer-Praxis*, Nr. 5/1973.
3. Klessmann, H., CAMAC System Configurations; *CAMAC Proceedings*, Issue 9/April 1974.

OBITUARY NOTICE

BRIAN EDWARD FREDERICK MACEFIELD†

The sad news of Brian's death on 1st October 1974 shocked and stunned all his ESONE, NIM and CAMAC Association colleagues following so closely on his recent election to ESONE Chairman 74/75 in Warsaw. In many ways, he was larger than life itself. Few failed to appreciate his robustness in argument and discussion and everyone enjoyed his company, his beaming smile and his kindly consideration for the small things that make life that much more pleasant to live.

After graduating at St. Catherine's College, Cambridge, Brian joined the Atomic Energy Authority at Aldermaston in 1958 and his early work with a neutron physics group involved him in an extensive use of computing techniques in the solution of complex numerical problems. He was associated with work on Monte Carlo type problems and he devised the Direction Reaction code which is used in scientific establishments both in Europe and the U.S.A.

In 1963 he joined the Nuclear Physics Laboratory at Oxford and formed a Computer Group. He pioneered the development of medium sized computers for on-line data collection and interactive analysis and several key publications have described his work. His efforts were not confined to the Oxford scientific community alone because he lectured in computing throughout the world and served as an adviser to several scientific committees.

Brian was aged 38 and leaves a widow and two young children to whom all his many colleagues throughout the world wish to express their sympathetic condolences.

His passing has robbed the ESONE Committee of a Chairman with great potential and determination to pursue a forward looking programme. In particular the Working Groups will not be the same without the enthusiasm and expertise which he gave to the development of the Serial Highway.

1 June 1974

ERRATA AND ADDENDA

TO SUPPLEMENTARY INFORMATION ON CAMAC INSTRUMENTATION SYSTEM

Supplement to CAMAC Bulletin No. 6, March 1973

Note: This Errata and Addenda to the Supplement of CAMAC Bulletin No. 6 (TID-25877 as NIM publication) has been approved by the NIM and ESONE Committees. It supersedes earlier Errata and Addenda and includes all items therein.

Page 16 - The section number should be L4.2.3a not L4.2.3. In the box reference should be to Section 4.2.3 not 4.2.4.

Page 16 - Add the following four sections:

L4.2.3b Command Accepted (BX) Response to Graded-L Request (BG)

References
TID-25876 EUR 4600e, 1972 Section 4.2.3

The generation of BX by Crate Controller Type A-1 is fully defined for Command Mode operations (Sections 4.2.3 and A1.8). Graded-L operations, however, are generally multi-addressed, in which case the BX signal at the branch driver is an unreliable indication that all crates have responded to the operation. Therefore, the Command Accepted (BX) response to a Graded-L Request (BG) is not defined. For the guidance of designers, it is recommended that:

1. When CCA-1 is addressed in a Graded-L operation it should generate BX = 0;

2. During a Graded-L operation the branch driver should not respond to the state of the BX line.

L4.6a Branch Highway Lines BV1-BV5, Free Lines

References
TID-25876 EUR 4600e, 1972 Section 4.6 and Table VI

In specification TID-25876 (EUR 4600e, 1972) the branch highway lines BV1 - BV5 were reserved for future requirements. Various users have since found the need for additional lines, particularly in complex configurations with multiple branches and multiple sources of commands. The NIM and ESONE Committees have therefore authorized the use of lines BV1 - BV5 as Free Lines for any use.

The specification of Crate Controller Type A (Appendix 1 to TID-25876 and EUR 4600e) is not affected by this change. No standard feature of CCA uses these lines, but they are linked between the two branch highway ports (Section 4.6). Additional features using these lines are virtually prohibited by Section A1.1.

Uses of the signal lines BV1 - BV5 and their return lines BV1R - BV5R must conform to the requirements of TID-25876 (EUR 4600e, 1972). Hence, signals on BV1 - BV5 must conform to Section 7 (for example, these lines cannot be used for other types of signals or for power supplies). Any signal that is asynchronous with respect to the Branch Operation should be generated from a source that defines the transition time in accordance with Sections 4.3 and 4.4.1. It should be noted that the BV lines are terminated at one end of the highway (and preferably at both ends) as specified in Section 7.3 and Table VIII.

(over)

No standard uses are defined for BV1 - BV5, and there may be conflicts between items of equipment using these lines in different ways. Designers and manufacturers with well-established conventions for the use of these lines are asked to inform the NIM Committee or the ESONE Committee, so that appropriate guidance can be given to other users.

LA1.4a Front Panel

References
TID-25876 EUR 4600e, 1972 Section A1.4

Subsection d) of Section A1.4 of TID-25876 (EUR 4600e, 1972) refers to Section 4.3.3 of EUR 4100e. This is in error. Reference should be to Section 4.2.5.

LA1.10a Dataway Inhibit (I) in Off-line State

References
TID-25876 EUR 4600e, 1972 Sections A1.5.3; A1.10 and Figure 7 TID-25875 EUR 4100e, 1972 Section 5.5.2

In TID-25876 and EUR 4600e, 1972 it is mandatory that units generating Initialise (Z) must also generate I. Units that can generate and maintain I must maintain I = 1 until specifically reset. See Section 5.5.2 of TID-25875 (EUR 4100e, 1972). Both these requirements are met by CCA-1 in the on-line state. However, Section A1.10(b) of TID-25876 (EUR 4600e, 1972) specifically prohibits the generation of I = 1 in the off-line state other than in response to the front panel Inhibit input. The off-line state has been defined in such a way that a manual or test controller can be used to test or set up equipment while the crate is off-line. Section A1.10(b) is primarily intended to prevent the generation of maintained I = 1 by CCA-1, since this has no manual means of resetting I and would obstruct any such off-line activities.

To be consistent with this aim:

1. Crate controller Type A-1 should generate I as presently defined in Sections A1.5.3 and A1.10 (and as shown in Figure 7);

2. Any Auxiliary means of generating commands in an off-line crate should conform to Section 5.5.2 of TID-25875 (EUR 4100e, 1972) by generating I = 1 in response to Z·S2. It should preferably maintain I = 1 and provide a means of resetting it.

Page B1- In the NIM-CAMAC Software Working Group, Richard F. Thomas, Jr. is Chairman and W. Kenneth Dawson is Secretary.

Page B1- In the NIM-CAMAC Mechanical & Power Supplies Working Group, Lee J. Wagner, LBL, is Chairman.

Page D1- In the CAMAC Dataway Working Group, R. Patzelt is Chairman.

Page D1- Delete the first CAMAC Analog Signal Working Group. The second AWG listed is the current one.

Page D1- In the CAMAC Analog Working Group, O. Fromheim should be identified as Secretary rather than as Chairman.

2

ON-LINE CONTROL OF A SYNCHRONOUS GENERATOR USING CAMAC

by

M.E. Newton and B.W. Hogg

Department of Electrical Engineering and Electronics, University of Liverpool, England

Received 17th June 1974

SUMMARY A laboratory system has been constructed to study direct-digital-control of turbogenerators in electric power systems. It consists of a model power system, connected to a hierarchical computer system through a CAMAC interface.

INTRODUCTION

Many recent publications have considered applications of modern control theory to improve or 'optimise' the performance of turbogenerators[1–3], and significant advances have been claimed in terms of stability and control. These schemes usually propose co-ordinated control of governor and excitation systems, and would be implemented by an on-line digital computer. This paper describes a laboratory system which has been constructed to investigate and assess the problems which arise in the practical application of such schemes. It consists of a micro-machine system with a hierarchical computer-control structure.

MICRO-MACHINE SYSTEM

The basic components are a 3 kVA micro-alternator and the separately-excited d.c. motor which drives it, (Fig. 1). The output of the alternator is connected to the laboratory busbar via a generator transformer and lumped series impedance with appropriate facilities for measurements, applying faults, etc. The alternator has two field windings, which are excited by three-phase thyristor bridges. The field current of the d.c. motor is held constant, so the torque it produces is proportional to the armature current I_a. This is controlled by a thyristor

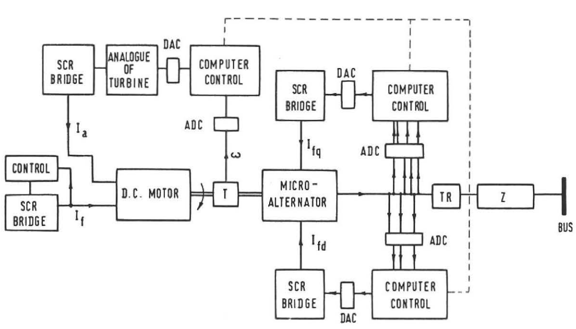

Fig. 1 Direct Digital Control Scheme

bridge, and is proportional to the output from an analogue simulation of the turbine. The system has been in use for some time with analogue controllers[4], but these have now been replaced by a digital computer, as shown in Fig. 1. Various quantities, such as terminal voltage, rotor angle, speed, etc. are measured and fed through a.d.c.'s to the computer. This calculates the appropriate control signals, which are output through d.a.c.'s.

COMPUTER SYSTEM

In principle, replacement of the original analogue controllers by digital equipment does not appear to present any great difficulty. However, in practice the specification of a precise hardware configuration and the implications in terms of software must be considered carefully. The system must be sufficiently fast to provide a significant level of on-line computation, and be able to deal with a variety of events with differing orders of priority. In particular, some form of interrupt facility is necessary to detect large disturbances and initiate immediate action. As a research facility, it is also desirable that the system be as flexible as possible, and suitable for future modification and extension.

At about the time that this was being considered, it was proposed that a computer system be established at Liverpool University for on-line experimentation and control. This would provide a service to other Departments, and would be based on a central computer in the University Computer Laboratory.
It was decided to set up this system initially between the Computer Laboratory and the Department of Electrical Engineering and Electronics.

The computer system has three distinct levels. A mainframe processor (40 K) is connected to a front-end processor (24 K) by a high-speed parallel data highway (30 000 baud). The front-end computer services a number of satellite mini-computers which are used for on-line experiments. This is shown schematically in Fig. 2.

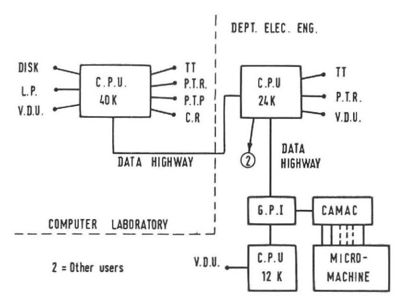

Fig. 2 Computer System

One of the mini-computers (12 K) is adjacent to the micro-machine, and connected to it by a General Purpose Interface (manufactured by UKAEA, Culham Laboratory) and a CAMAC system. The mini-computer has access to the mainframe processor via the 24K machine. This scheme has a number of advantages. The extensive and costly peripheral equipment in the Computer Laboratory is available to the satellite computer, so that few peripheral devices are necessary on site. All main programs are developed and tested on the 40K computer.

HARDWARE INTERFACE

This is a CAMAC system, employing a Type A1 crate controller. The adoption of a modular hardware system which conforms to internationally standardised specifications has obvious advantages. It is a very flexible arrangement which can be altered or extended easily and economically, and is of proven reliability. Initially, to minimise the problems involved in changing over to direct digital control (d.d.c.), it was decided to make as little alteration as possible to the original system. Consequently, the existing transducers were used to supply analogue signals to a.d.c.'s. In the future, these will probably be replaced by digital transducers.

The outputs from the computer are taken through d.a.c.'s to controllers in the field circuits, and hence via drivers to the thyristors. When the system has been thoroughly tested, the controllers will be removed, and the outputs from the computer will control the firing of individual thyristors. In the simulation of the turbine and governor system, the computer provides the input to an analogue simulation of the turbine (Fig. 1).

In addition to d.a.c.'s and a.d.c.'s, the CAMAC modules include a LAM grader, branch terminator, real-time clock, registers, etc. This is sufficient to implement d.d.c. of the micro-machine. Subsequently, in the light of operating experience, further modules will be obtained or constructed, as necessary.

SOFTWARE

The mainframe computer works under E4[5], an executive system with multi-programming and multi-access facilities. The front-end processor and mini-computer use MISER[6], which is adaptable, and economical on core space. All the system software, including the subroutines to manage CAMAC, is written in CORAL 66[7], a general-purpose language designed for real-time applications.

CONCLUSIONS

The laboratory system which has been described here is now being tested. It will be used to study the integrated control of governor and excitation systems for generators in power systems, and to determine the extent to which optimal control can be achieved.

ACKNOWLEDGEMENTS

The authors are grateful to the technical staff in the Department of Electrical Engineering and Electronics, University of Liverpool, and the staff in the Computer Laboratory, who have made a major contribution to the development of this system.

They are also grateful to the Science Research Council for financial support.

REFERENCES

1. Evans, F. J., Ngo, Y. H., Outhred, H. R., On-line Digital and Optimal Control of Generator Excitation, CIGRE, 1972, Paper No. 32-05.
2. Anderson, J. H., The Control of Synchronous Machine using Optimal Control Theory, *Proc. IEEE*, 1971, 59, p. 25.
3. Nicholson, H., Integrated Control of a Non-linear Turbo-alternator Model, *Proc. IEEE*, 1967, 114, p. 834.
4. Hammons, T. J., Hogg, B. W., Lewis, D. G., A Micro-alternator system for Power System Stability Studies, *Proc. 7th Univ. Pwr. Eng. Conf.*, Bradford, 1972, p. 80.
5. E4 Executive, Computer Technology Ltd., Modular I Product Description 381/47.
6. Calderbank, M., MISER- a Minimum Size Executive for the Modular I, UKAEA Research Group, CLM-PDN 1/73.
7. Official Definition of CORAL 66, HMSO, 1970.

NEWS

CAMAC IN INDUSTRIAL CONTROL SYSTEMS

During the Annual Meeting of the I.E.E.E. — Industrial Applications Society, Pittsburgh — October 7-10 1974, several papers were presented that considered CAMAC in industrial control systems:

— 'Standardized Instrumentation System for Computer Automated Measurement and Control'
Louis Costrell, National Bureau of Standards.

— 'Interfacing Standardization in the Large Control System'
Frank Willard, Westinghouse Electric Corporation.

— 'Functional Instrumentation Modules'
Lowell Klaisner, Kinetic Systems,
Frederick Joerger, Joerger Enterprises.

— 'System Design Considerations When Using Computer-Independent Hardware'
William Lyon and Dale Zobrist, Aluminum Company of America.

— 'Serial Data Highway for Remote Digital Control'
Lowell Klaisner, Kinetic Systems.

— 'Demonstrating Process Control Standards - an Exercise in Success'
Felix Bearden, Modular Computer Systems,
Paul Fassbender, Data General Corporation.

3

A FAST MULTI-USER CAMAC SYSTEM FOR DATA ACQUISITION, WITH AUTONOMOUS CONTROLLERS

by

Per Høy-Christensen

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Received 24th June 1974

SUMMARY This multi-user multi-crate CAMAC system for data acquisition is controlled by an RC 4000 computer, and uses command generators for autonomous transfers. Look-at-Me demands are serviced through the Branch Highway, in conjunction with control highways within each crate. Some applications of the system are described.

INTRODUCTION

The tandem accelerator laboratory of the Niels Bohr Institute is located 35km from Copenhagen near Roskilde and is centred around a Van der Graaff accelerator. This 9.5MV machine is capable of producing fast accelerated ions which are used to bombard targets of different elements for investigations of nuclear structure.

In 1970 the laboratory received a large Danish-manufactured time-sharing computer, 'RC 4000', now equipped with 64k words of 24-bit core store, 512k drum, 2M disc, 2 IBM-compatible magtapes, and a dual graphic display unit with refresh memory. It was mainly to be used for on-line data collection from the nuclear electronics, but also for processing the data. It was planned to use a CAMAC multicrate system in order to interface several fast nuclear analogue to digital converters (ADC), memories of existing pulse-height analyzers, scalers etc. A decision was taken to use commercially-available CAMAC equipment whenever possible. Therefore it was decided to use the normal branch highway system. One of the aims was to make the system as flexible and reliable as possible, because the experiments are changed from day to day. It should also include the possibility of operating as a multi-user system.

SOFTWARE CONSIDERATIONS AND SOLUTION

As a multi-user system, it needs software protection against mutual destruction of the data belonging to different simultaneous users. Generally one CAMAC module can only be utilized by one user at a time, while the crate itself can be shared.

The solution of the software structure will be described in a future paper.

SYSTEM IMPLEMENTATION

In order to handle the fast data-flow it was necessary to use the direct memory access of the computer, because a system based on interrupts alone would be much too slow. But the problem was then to get a flexible control of the CAMAC system.

We chose to combine some features from the old Harwell 7000 series multicrate system[1] with the Branch Highway of the ESONE multicrate system. The Harwell system used small controlling units called 'Sequential Command Generators' (CG) connected to a small active store. These CG's could be applied with minor modifications. A specially designed command generator called 'Entry Condition Command Generator' (ECCG) is used for computer control of the different units.

The computer interface is divided into two parts: a general interface for the computer and a Branch Driver (BD) for the CAMAC system.

The interface is designed with 8 channels. It allows each on-line user to operate one or more channels. One of the eight channels is normally used for control and is shared between the users. Start and end addresses for each channel, specified by the computer monitor, define an area in the core store and are loaded into a register stack in the interface. The channels can be enabled to operate in three modes: random access mode, block mode, and control mode. A 3-bit code specifies which channel the CAMAC system wants to access. Two

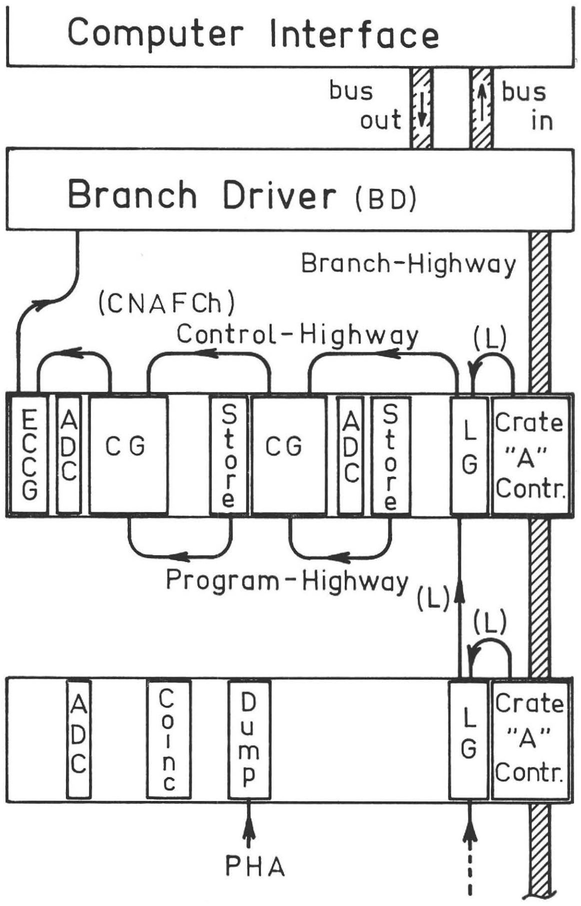

Fig. 1 System Configuration

24-bit data buses for incoming and outcoming data, with optocouplers for galvanic separation, are included in the interface.

The branch driver couples the Branch Highway to a Control Highway for commands from the CG's, as well as to the communication bus from the computer.

The system configuration is shown in Fig. 1.

In each crate the 'Look-at-Me' signals (L) from the Crate Controller A and the previous crates are patched in a special designed 'Lam Grader' (LG) also giving the possibility of using normal branch demands for special module interrupts. From the LG's, the L signals are connected to the CG's by means of the 'Control Highway'. In the CG there is a scanner which scans all the L signals cyclicly.

Each L number is an address for the program store which can be read by the CG via a special 'program highway'. The store is loaded through the Branch Highway and Dataway. A 2-bit code in the store specifies the start, continuation and end of an autonomous transfer and the subsequent bits give the CNAF code and also the channel code (Ch) for a possible computer transfer.

If a certain L demands an autonomous CAMAC transfer, and the appropriate CG has been enabled, this CG is ready to start a sequence of CAMAC operations. It indicates this by a request flag on the control highway. When permission is granted by the Branch Driver, the instructions from the CG are passed through the control highway to the Branch Driver and distributed to the different crates via the normal Branch Highway.

Permission is granted to the different CG's according to a priority scheme but, after the first CG, only those CG's that already have given a request will be served, one after another. This feature is one of the changes compared to the original Harwell system.

When the computer wants to control the system (to enable some units, load CG stores etc.) it signals to the ECCG by means of a special flag line from the interface. This ECCG has the highest priority, but its action can be delayed just as the other CG's until an existing CG operation in progress has been completed, which can be detected from the control highway. The information for it is then passed through the Branch Highway.

The interface will immediately disable a CG when data stored in sequential block mode reaches the end address of the data area, or if an address for random access mode exceeds the specified area in the core store. Under these conditions an interrupt is sent to the program. The computer program must then take the initiative to re-enable the CG, if necessary.

SYSTEM APPLICATION

An application for one user could be a coincidence setup of several parameters. Each detector for gamma rays or particles is connected to an ADC. When a certain ADC completes a digitization, the L from this ADC starts a sequence which reads and clears the ADC, writes the ADC word to a buffer register in a coincidence module, presents the ADC word as an address to the interface in random access mode, reads out the contents of the computer word and increments this. If an event digitized by an ADC has no correlation with other ADC's, only the last part of the sequence is effective because the coincidence module is blocked. It will just give a contribution to the single spectrum. When the coincidence module has received all the parameters, it also gives an L. It will then be read and cleared, and the combined data word is presented to the interface in block mode, which gives a contribution to the multiparameter spectrum. Because of this philosophy it is possible to get different coincidence combinations, besides the single spectra, from the same experiment.

It is also possible to interrupt the program by means of branch demands from a presettable control scaler.

Another application is a parallel dump of 4k memories from pulse-height analyzers. This is done in pure block mode operation.

FURTHER DEVELOPMENTS

One of the future applications will be to use the CAMAC system to interface a Teletype-compatible device with storage screen, instead of using the normal computer bus that serves other peripherals. This shows that the modularity and standardization of the CAMAC system are strongly justified.

Although the old design of CG has proved its worth, another improvement of the system will be to design a new version of CG. This design has already been started. One new feature of this CG will be that it will contain a register stack with a LAM-table giving a reference address to the CG store. Only those L's which have a program in the store will be scanned. This idea gives much faster scanning. In addition, the frequency of the scanner itself can be much improved by using new technology.

The new CG will also have the facility to execute conditional commands based on the Q response from a module. The advantage of all this will be a much faster action than a normal computer response.

CONCLUSION

In practice during the last couple of years this CAMAC system has proved to be very flexible and effective and the increased costs of the basic system have been recovered during the further developments.

ACKNOWLEDGEMENT

The author would like to thank Anders Holm and Peter Møller-Nielsen who, during their software design, have made many valuable contributions to the development of the system.

REFERENCES

1. Richards, J. M., '7000 Series CAMAC Controllers', *AERE Report*, M2145, 1969.
2. Christensen, P., Høy-Christensen, P. and Munkøe, L., 'CAMAC in Denmark', *CAMAC Bulletin*, No. 7 July 1973, pp. 11-12.

DEVELOPMENT ACTIVITIES

1

CAMAC READ-OUT SYSTEM FOR WIRE SPARK-CHAMBERS OR MULTI-WIRE PROPORTIONAL-CHAMBERS

by

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Received 9th April 1974

SUMMARY This system includes a dual 16-bit read-in module, with variable-threshold differential inputs for the signals from the ferrite core store of a wire spark-chamber or the amplifiers of a multi-wire proportional spark-chamber. A 16-channel ferrite-core-store driver module generates output pulses of adjustable amplitude, width and polarity.

INTRODUCTION

Spark and multi-wire proportional-chambers are used as particle detectors for high-energy physics experiments. Wire spark-chambers contain the information about the track of the particle in their ferrite-core memory. Multi-wire proportional-chambers supply a continuous flow of 'small-signal' information.

So for read-out from these detectors a 16-channel single-pulse driver (16× bipolarer Treiber[1]) and a dual 16-input receiver (2×16 Read-In[2]) have been designed.

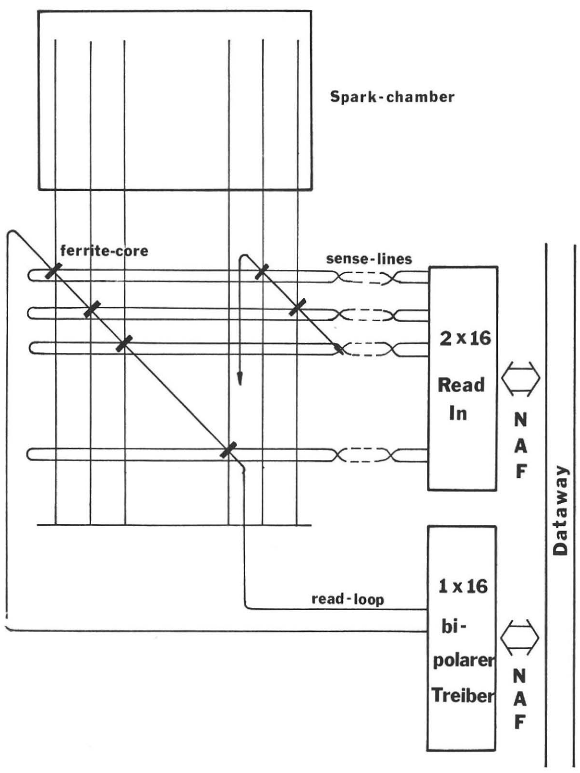

Fig. 1 Spark-chamber Read-out

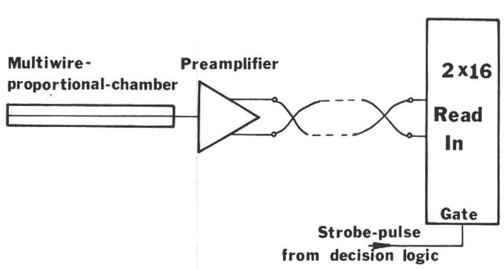

Fig. 2 Proportional-chamber Read-out

16-CHANNEL DRIVER

This single-width CAMAC module features outputs for positive or negative polarity pulses on 16 channels. The pulse width may be varied by a potentiometer on the front panel; the pulse height depends on the externally connected power supply (within the maximum ratings of the output transistors). Additionally, the rise and fall times of each output can be adjusted. The command F(12) causes a pulse of negative polarity, and F(14) a pulse of positive polarity on the output selected by sub-address. This is useful for testing ferrite cores, which may be set by a positive pulse and reset by a negative output pulse.

2×16 READ-IN

This single-width module accepts differential-signal input data, changes it (depending on the variable threshold) to TTL-levels, stores it in two 16-bit parallel entry registers and transfers it to the Dataway in Read commands. Registers are cleared by External Clear or from the Dataway. External gate inputs for each register, and a common Disable from the Dataway, are provided. Data entry into the registers causes a LAM to the Dataway and a signal to the DC-OR output (NIM) on the front panel. Input sensitivity can be adjusted between 5-500 mV by the variable threshold. The polarity of the threshold.

The signals are received undelayed, and are stored. The external NIM-logic decides whether the information in the registers is to be cleared or transferred to the Dataway. During the decision time of the logic the input gates are disabled. That is the reason for this system working with a dead time. It will be used only for lower counting rates.

REFERENCES

1. Pernicka, M., Pregernig, L., 16× bipolarer Treiber, HEP IV/1974.
2. Pernicka, M., Pregernig, L., 2×16 Read-In, HEP III/1974.

2

OPTICAL LINK FOR THE CAMAC BRANCH HIGHWAY THROUGH A SCREENED CAGE

by

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Received 26th April 1974

SUMMARY Plasma physics experiments cause enormous electro-magnetic interference, and therefore measuring equipment is usually situated in a screened cage. For data communications to a central computer the CAMAC parallel Branch Highway passes through the wall of the screened cage via an optical link.

SYSTEM DESCRIPTION

In our Laboratory we have a PDP-15 computer with a CAMAC CA-15 interface for on-line data acquisition and control of several plasma-physics experiments. At some of these experiments fast capacitor discharges take place (100-1000 kJ within a few microseconds), not only making a problem of how to control the experiment, but even powerful enough to destroy any measuring equipment.

To protect the computer and its peripherals, all instruments in the vicinity of the experiment are located in a screened cage. The computer is situated in the centre of the building, far from the experiments, to serve a number of them. The communication between computer and screened cage is accomplished by the Branch Highway (see Fig. 1), consisting of a double-screened cable (100 metres long) with twisted conductor pairs. At both ends the cable is connected to symmetrical line drivers (DM 8831) and line receivers (SN 75107). To avoid ground loops via the ground connections of the computer and the screened cages (when such a loop is present the computer does not function correctly) a galvanic isolation between computer and cage is necessary.

By using an optical coupling through the shielding walls of the cage, a conducting loop in the Branch Highway cable is avoided and the high-frequency common-mode interference is decreased to a bare minimum.

Another important benefit is that, by optical coupling in and out, no signal interference is transferred into the screened cage. For this reason all other signal and command conductors are optically coupled into the screened cage and out of it.

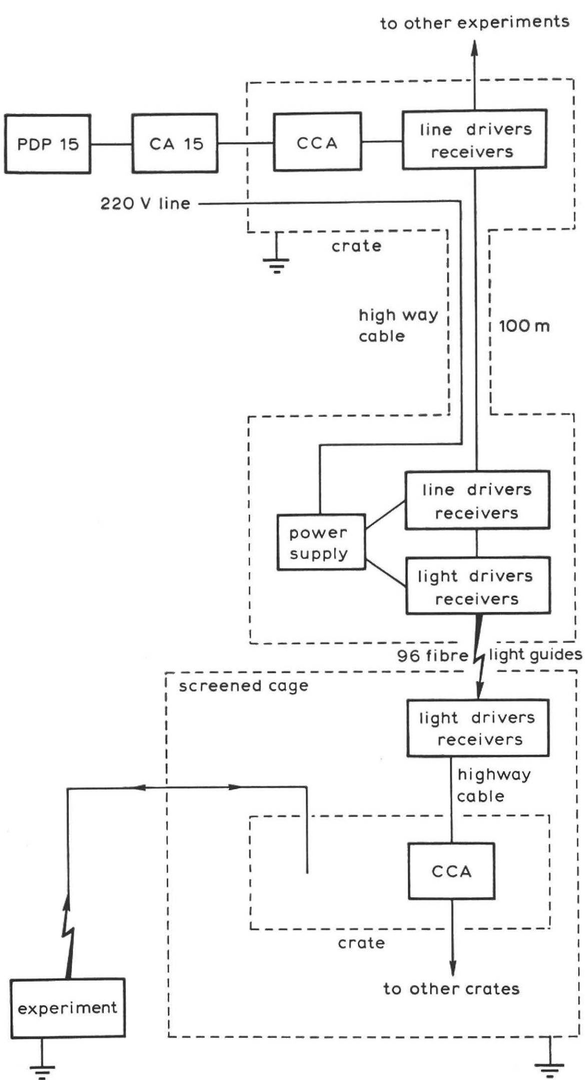

Fig. 1 Schematic Diagram of Branch Highway System with Optical Link

OPTICAL LINK

The optical coupling comprises a light-emitting diode (Monsanto, type ME4), a light-conducting glass-fibre bundle (5 mm cross section and 50 cm long), and a photo diode (Monsanto, type MD2). Outside the screened cage a unit containing line drivers and line receivers, light drivers and light receivers, and a power supply, is enclosed by a double-shielded case. The Branch Highway cable is fed into this case together with the power line from the computer. The light guides pass into the screened cage through the holes of the mesh-window. In the screened cage are light drivers and light receivers, translating to the standard configuration of the Branch Highway to which the Crate Controllers Type A are connected. The total delay of the light coupling, including the line driver and line receiver, is 100-250 nanoseconds. The difference between individual channels is caused by the spread in performance of the light-emitting diodes and the optical fibre bundles.

To achieve correct timing of the Branch Highway the difference in delay is compensated by an extra delay in the BTA and BTB signals.

ACKNOWLEDGEMENTS

This work is part of the research programme of the association agreement of EURATOM and the 'Stichting voor Fundamenteel Onderzoek der Materie' (FOM) with financial support from the „Nederlandse Organisatie voor Zuiver-Wetenschappelijk Onderzoek" (ZWO) and EURATOM.

3

A FAST DIGITAL MULTIPLIER FOR CAMAC

by

P. Hawkins

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Received 10th June 1974

SUMMARY This CAMAC module has been developed at CERL for telecommunication-signal cross-correlation in an experimental power-system protection scheme. It multiplies two 12-bit numbers in 280 ns.

INTRODUCTION

In connection with studies of improved telecommunication signalling methods, particularly for power system protection applications, systems using digital matched filters are being developed at CERL. The filtering is achieved by correlation techniques in which samples of signals from the communication channel are cross-correlated with a stored replica of the expected signal waveform. The cross-correlation involves multiplication and averaging.

For reasons of convenience it was decided to use CAMAC for an experimental protection intertripping system. However, it was found that a suitable digital multiplier was not available as a CAMAC module. This paper describes the design of a module which has been constructed at CERL to fulfil the requirement, and which is generally applicable by users of CAMAC requiring a fast 12-bit multiplier.

METHOD

There are two common methods of achieving multiplication in digital systems, using either software multiplication or a specialised hardware device. The software approach is wasteful in program storage space and in execution time, especially in autonomous CAMAC systems where the program space may be limited, and a typical 12-bit CAMAC multiply routine may take one or two ms.

In the hardware approach the system can be either a shift-and-add serial process or a parallel logic process. The former requires clocking, using more sophisticated logic circuits, and is also quite slow. Using standard logic circuits a serial 12-bit multiplier would have a multiply time of 20-40 µs. CAMAC read-write cycles in a 7025 controller take approximately 6 µs and so to be able to multiply within one such cycle the operating time of the multiplier is chosen to be less than this. In fact the choice of integrated circuit defines the speed at 280 ns.

Design Details of Multiplier Block

The multiplier makes use of an integrated circuit (Fairchild, type 9344) which has recently become

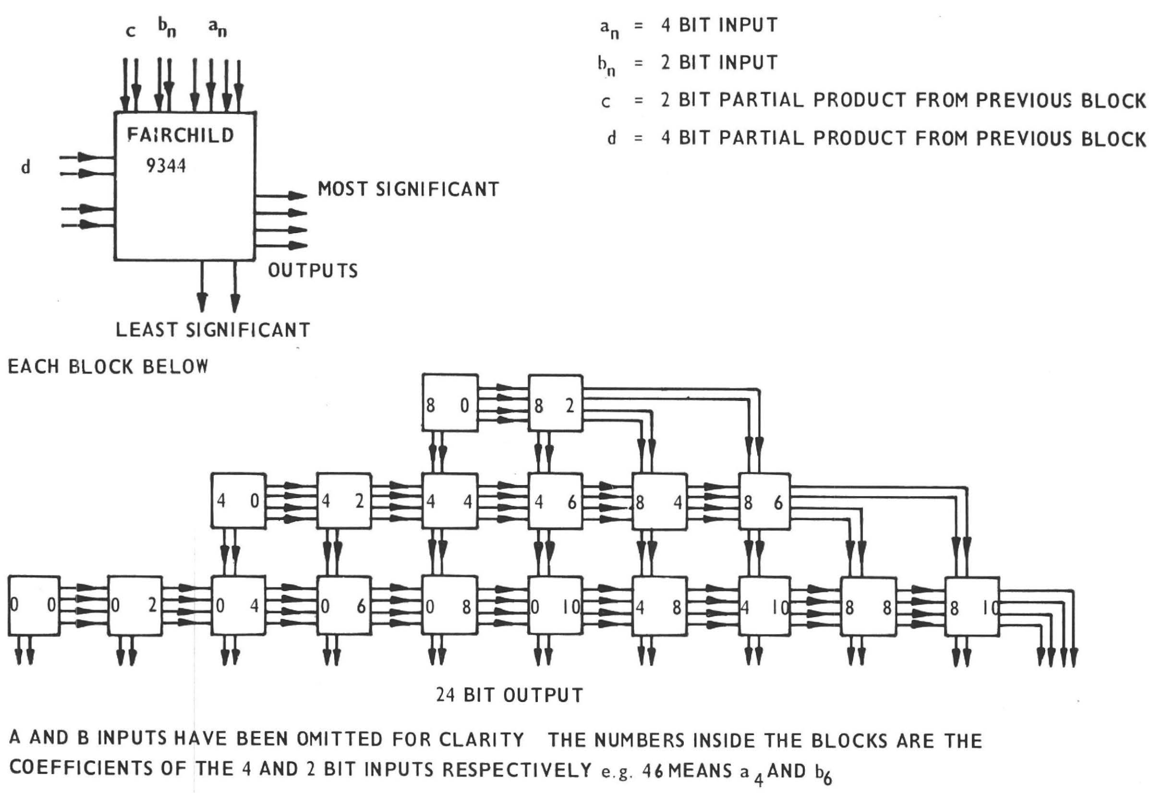

Fig. 1 Schematic Diagram of Multiplier Module

available, using medium scale integration techniques. The device is an interconnection of gates and adders which forms a digital 4-bit by 2-bit multiplier, producing a 6-bit product. The CAMAC module described uses eighteen integrated circuits type 9344, interconnected so as to form a 12-bit by 12-bit multiplier. This is achieved by subdivision of the two 12-bit words into three 4-bit words and six 2-bit words respectively, e.g. if A and B represent the two 12-bit words, then they may be represented as:

$$A = a_0 . 2^0 + a_4 . 2^4 + a_8 . 2^8$$

and:

$$B = b_0 . 2^0 + b_2 . 2^2 + b_4 . 2^4 + b_6 \ 2^6 + b_8 . 2^8 + b_{10} . 2^{10}$$

where a_0 represents the four least significant bits of A, a_4 represents the middle four bits etc., and b_0 represents the two least significant bits of B etc. Thus the product $A . B$ will be represented as:

$$AB = a_0 b_0 . 2^0 + a_0 b_2 . 2^2 + (a_0 b_4 + a_4 b_0) . 2^4 +$$
$$+ (a_0 b_6 + a_4 b_2) . 2^6 + (a_0 b_8 + a_4 b_4 + a_8 b_0) . 2^8 +$$
$$+ (a_0 b_{10} + a_4 b_6 + a_8 b_2) . 2^{10} + (a_4 b_8 + a_8 b_4) . 2^{12} +$$
$$+ (a_4 b_{10} + a_8 b_6) . 2^{14} + a_8 b_8 . 2^{16} + a_8 b_{10} . 2^{18}$$

The ten partial products so formed may be combined to provide the 24-bit word as shown in Fig. 1, from which the input connections have been omitted for clarity.

Input Circuits

The multiplier is designed to operate on 12-bit numbers presented on the least significant bit positions of the CAMAC Dataway. These bits are therefore gated into the input registers of the multiplier on receipt of the appropriate program commands.

Standard 4-to-16 line decoder circuits are used to decode the sub-address, station address and function outputs from the CAMAC Dataway. The input gating is such that the A input register is loaded with the 12 bits of data from the Dataway by an overwrite (F16) instruction on sub-address 0 or 2. The B input register is loaded similarly at sub-address 1 or 2. The outputs from the A and B registers form the inputs to the multiplier shown in Fig. 1.

By appropriate selection of the sub-address the input information may thus be loaded, either separately into each of the two registers for multiplication or, alternatively, simultaneously into both registers for squaring.

Output Circuits

The CAMAC read-write instruction time is substantially greater than the propagation time through the multiplier chain (1 μs minimum for CAMAC instructions against 280 ns for 12 × 12 bit multiplication). This means that there is no need for the multiplier to give a response to indicate that it has finished. The product can be read by the next CAMAC instruction.

The outputs from the multiplier are inverted and then gated by a read instruction (FO), at sub-address 0, onto the 24 read lines of the Dataway.

CONSTRUCTION

The prototype was constructed as a double-width CAMAC module because integrated circuit sockets and ordinary wiring were used. A version with soldered connections and printed circuit wiring would occupy a single-width module.

PERFORMANCE

A measurement of the time taken from input gating to output product gave a value for propagation time of approximately 0.25 μs, as specified by the manufacturer of the multiplier circuit. The module was checked in a CAMAC program by multiplying every possible 12-bit number (between 0 and 4095) by every other number, giving nearly 17 million calculations, in both a software multiplication routine and the new module. Subtraction of the outputs of the two multipliers gave a result of zero showing correct functioning. In the event of a result other than zero the program would have stopped and displayed the current input numbers. The multiplier twice passed this test.

The module has been successfully used in a CAMAC system for correlation measurements at CERL.

CONCLUSION

A 12-bit multiplier with a basic operating time of 280 ns has been designed and built as a CAMAC module. Its performance is such that input data may be fed in on one CAMAC instruction and the output read on the next. The approximate component cost of the module was £200. The design is suitable for general use in CAMAC where a fast digital multiplier is required.

ACKNOWLEDGEMENTS

The work described in this Note was carried out at the Central Electricity Research Laboratories and is published by permission of the U.K. Central Electricity Generating Board.

4

A CAMAC INTERFACE FOR TEKTRONIX WAVEFORM DIGITIZERS

by

J. P. Vanuxem

NP Division, CERN, Geneva, Switzerland

Received 10th June 1974

SUMMARY A CAMAC module has been designed, as a result of collaboration with Tektronix, to interface the Digital Processing Oscilloscope (DPO) and the Transient Digitizer (R7912) to the CAMAC Dataway.

INTRODUCTION

In the field of signal analysis, TEKTRONIX have recently issued two powerful digitizers, which are normally connected to a computer to realise their full capabilities. These instruments are the Digital Processing Oscilloscope (DPO) and the Transient Digitizer (R7912). They can digitize analogue signals, and usually store them in an internal memory before the digitized waveforms are read and processed by the computer. Both the DPO and the R7912 can acquire fast repetitive signals. The DPO can, in addition, record slow single events, while single events with sub-nanosecond rise times can be captured by the R7912.

Until now TEKTRONIX usually provided their customers with a complete system consisting of either of these waveform digitizers directly interfaced to a PDP-11 mini-computer. Direct interfacing with other computers, although quite possible, creates some problems owing to the great variety of mini-computers available to-day. Therefore, it was felt strongly desirable, particularly in CERN, to have a standard CAMAC interface. Any CAMAC user could utilize this to connect a TEKTRONIX instrument to his own computer, without having either to buy a 'dedicated' (PDP-11) computer, or to build a special interface to an existing computer.

GENERAL DESCRIPTION

This interface is a double-width CAMAC module. It will usually drive only one Acquisition, Processor and Display (APD) assembly (which becomes a true digital processing oscilloscope when connected to a computer), or one R7912 Transient Digitizer. However, it can drive a combination of up to 8 of these instruments, which are linked together and to the interface through a common bus. Fig. 1 shows an example of a system consisting of two APD's and one R7912.

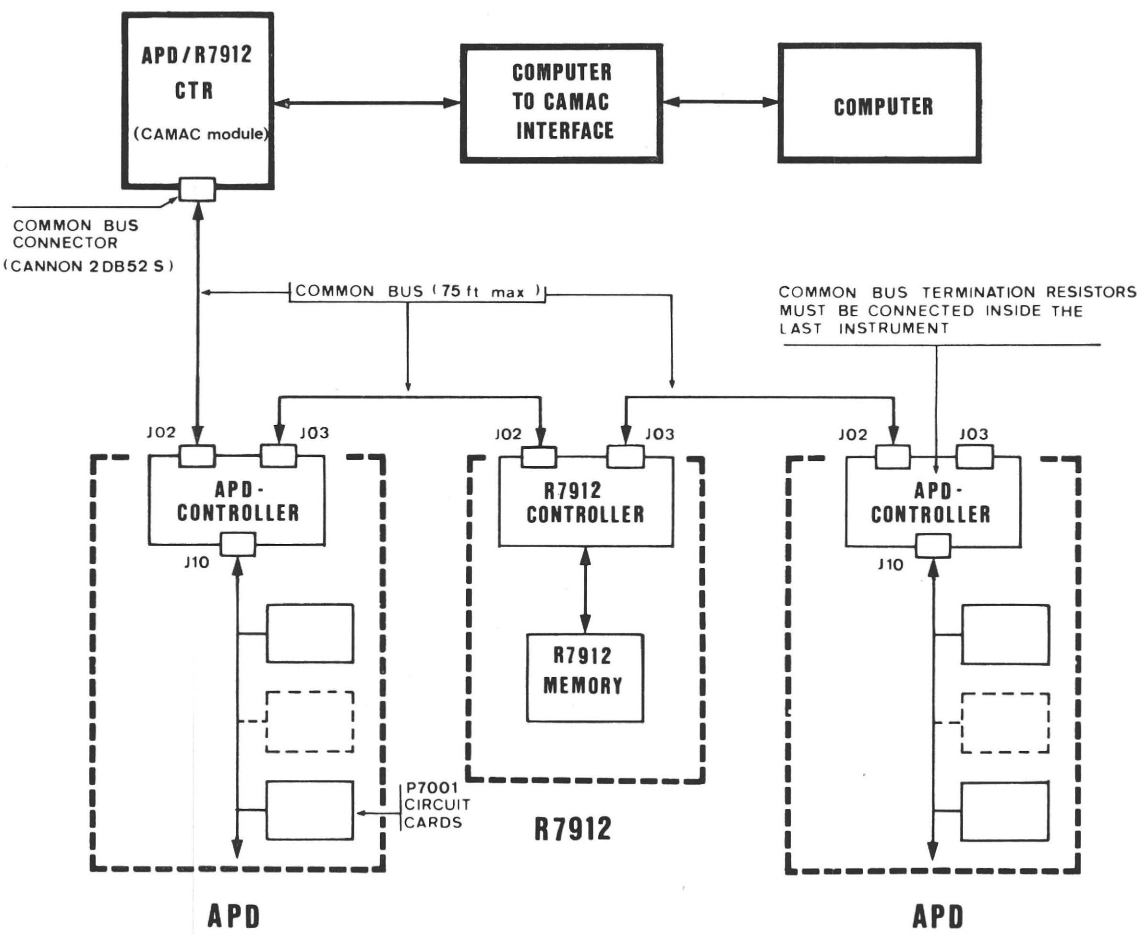

Fig. 1

Common Bus Structure

The common bus consists of 26 unbalanced twisted pairs and is responsible for transferring information (address, data or interrupt) between the interface and each instrument. Under normal environments its total length can be as much as 75 feet. Three kinds of transactions can be performed on the common bus during a normal command operation: they allow the interface to WRITE ADDRESS, WRITE DATA (APD only) or READ DATA via the controller of an instrument. Both types of instruments have an internal memory, but this memory is accessed differently: the R7912 contains a purely sequential memory (which the interface can only read not requiring any address information before transferring data; the APD, on the other hand, has a random access memory

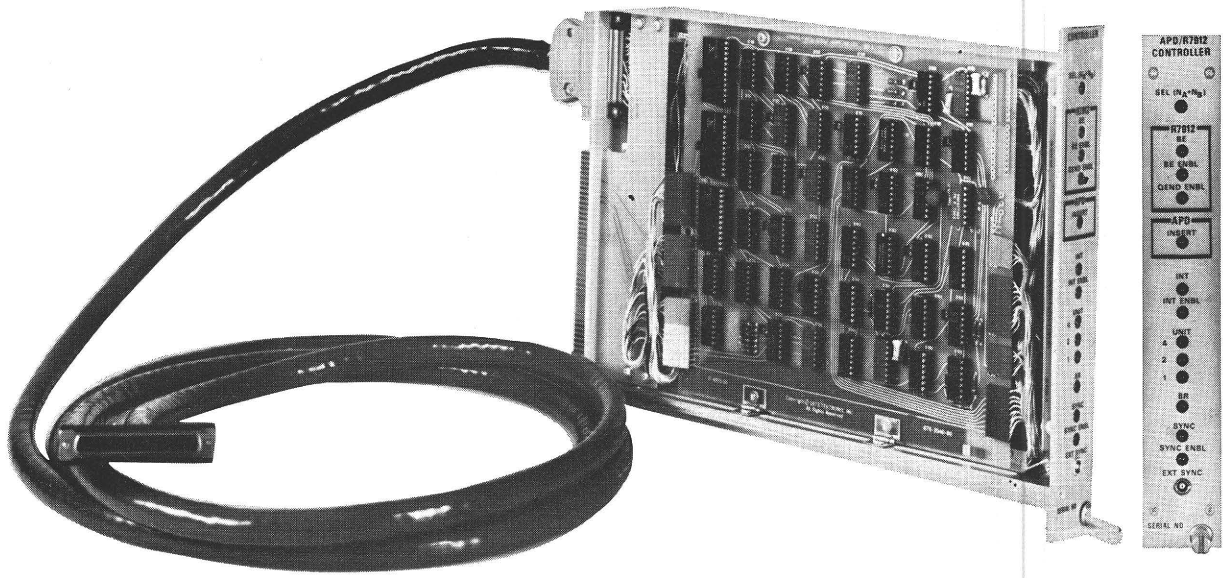

Fig. 2 The Interface Module

necessitating a WRITE ADDRESS operation before either a WRITE DATA or a READ DATA operation is performed. Nevertheless, the APD memory is usually scanned through by reading (or loading) a complete waveform which occupies 512 consecutive ('sequential') locations. An automatic insertion of WRITE ADDRESS operations between successive READ DATA (or WRITE DATA) operations on the common bus has been implemented in the interface, with incrementation of the address value.

This feature allows a continuous CAMAC data flow, even with the APD random access memory, thus permitting block transfers of data on the CAMAC Dataway in all cases. When transferring a block of data to (or from) an APD, only the starting address of the block in the APD memory has to be given to the interface, and, after having enabled the automatic address-increment feature, the computer can then open a DMA channel to transfer a block of data at full speed.

CAMAC Features

A block transfer (Read or Write) with an APD has always a defined length (usually 512 words), but a block transfer (Read only) with an R7912 has an unknown length, in which case the response $Q=0$ is used to terminate the block. As an alternative, a LAM can also be used to notify the computer that the end of the block has been reached. In both cases, the CAMAC operations can be synchronized by means of the HOLD feature, or a LAM-line, or the P1 line, or a front-panel connector. All the possible combinations of these block transfer facilities therefore give a wide choice to the CAMAC system designer.

Although block transfers of data are used extensively by this CAMAC module, program control instructions are also possible. The repertoire of instructions gives the software user full flexibility and consists of 9 data register instructions and 19 LAM-handling instructions.

In the interface, input and output data buffers allow a time overlap between CAMAC cycles and common bus cycles.

Three LAM sources are available:

- SYNC (state of readiness of the interface);
- BE (end of block, from the R7912);
- INT (interrupt from one of 8 instruments).

These LAM sources have 3 associated mask bits for software control. In the interface the instruments have an assigned priority which allows multiple interrupts to occur simultaneously on the common bus. Two Dataway connectors allow better LAM handling.

This interface is a standard CAMAC double-with module fulfilling all requirements of the 1972 edition of EUR 4100.

REFERENCE

For a more detailed description, see:
CERN CAMAC Note 51-00
(APD/R7912 Controller type 161)

5

A SYSTEM CONTROLLER FOR SIGMA 2/3 RXDS COMPUTERS

by

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Received 17th June 1974

SUMMARY This system controller for program-controlled operations interfaces the SIGMA 2/3 RXDS computer to the CAMAC Branch Highway. It was developed in order to introduce CAMAC into the Max-Planck-Institut für Kernphysik, as no other controller for the SIGMA 2/3 computer was available.

INTRODUCTION

At the Max-Planck-Institut für Kernphysik, Heidelberg, a CAMAC System Controller for programmed data transfer between the CAMAC Branch Highway and a SIGMA 3 computer (RXDS) has been developed. The three functional parts of the System Controller (Branch Driver, Logic, and Computer Interface) allowed modular construction. Some of the functional units, the CAMAC oriented ones, belong to manufactured products[1].

DATA TRANSMISSION

The basic element of SIGMA 3 information is a 16-bit word. Therefore two data memories exist in the System Controller, one for eight and one for sixteen bits, to subdivide a 24-bit CAMAC word. Hence, a complete transmission of a 24-bit CAMAC word needs two computer read or write operations. Four Crate Registers, and registers for Station Number, Sub Address and Function are used to specify the address of the information to be transferred. The N and A registers, and one C Register, are shift registers.

They allow address scanning at the end of every CAMAC cycle without any further instruction.

All the C Registers are available for multi-crate addressing. The fourth C Register is a status register, which serves to control the on-line crates. Its use for addressing is limited to Graded-L operations.

For systems with less than four crates it is sufficient to load the Crate Registers once at system initialisation. Two bits of the 16-bit SIGMA 3 address-word are used for the selection of one of the three C Address Registers. A CAMAC cycle, once started, has to be terminated after 10 μsec. Time out errors, perhaps due to false addressing, will create a SIGMA 3 interrupt by 'Crate Failure'.

DEMAND HANDLING

There is a second interrupt port between SIGMA 3 and CAMAC, which is used for transmission of the CAMAC Branch Demand Signal. Any request can generate a Graded-L operation. The status of the Crate Failure, Branch Demand and C Response lines can be tested by using the SIGMA 3 Overflow and Carry indicators.

OTHER FEATURES

The state of all important transmission lines and status information is indicated by 82 LED's/lamps which make control and error detection easy. Transmission times between the computer and the CAMAC system are shown in Fig. 1. CAMAC cycles, with the exception of Graded-L operations, are terminated 4.3 μsec after initiation. Another CAMAC cycle can be performed after 7.2 μsec by SIGMA 3. At present there is no need and no possibility for DMA transfers. Every operation takes place under program control.

CONCLUSION

If there is no need for fast data acquisition, this simple programmed-transfer interface can be used. The first application was in interfacing the Heidelberg $(\pi/2)\sqrt{13}$ high-resolution β-spectrometer[2]. Details of this on-line connection and the software support are reported in ref. 3.

REFERENCES

1. Borer Electronics, Solothurn, Switzerland, 'Interface 2200 Series—CAMAC Section'.
2. Daniel, H., Jahn, P., Kuntze, M. and Martin, B., *Nucl. Instr. Meth.*, *82* (1970) 29.
3. Wiemers, M., Diplomarbeit Universität Heidelberg, Heidelberg (1973) unpublished.

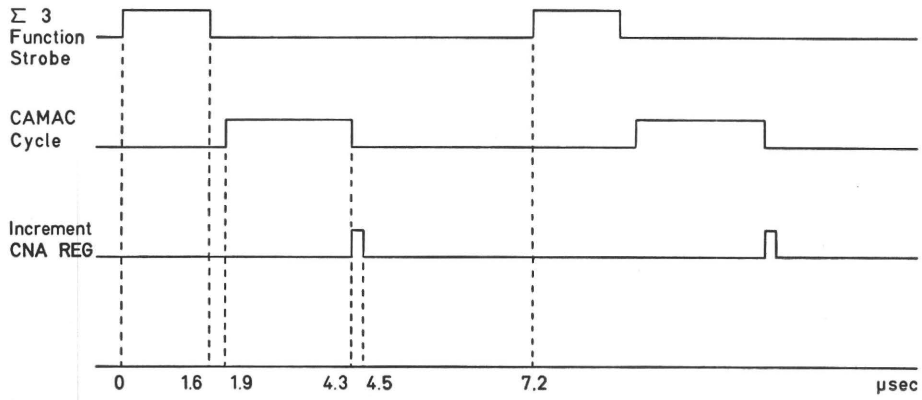

Fig. 1 Timing of SIGMA 3/CAMAC Operations

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CAMAC PRODUCT GUIDE

This guide consists of a list of CAMAC equipment which is believed to be offered for sale by manufacturers in Europe and the USA. The information has been compiled by CERN-NP-Electronics and is mainly based on information communicated by manufacturers and available up to the 10th October 1974.

Every effort has been made to ensure the completeness and accuracy of the list, and it is hoped that most products and manufacturers have been included. Inclusion in this list does not necessarily indicate that products are fully compatible with the CAMAC specifications nor that they are recommended or approved by the ESONE Committee. Similarly, omission from this list does not indicate disapproval by the ESONE Committee.

> Readers are advised to send their addresses to manufacturers in order to be on their mailing list for current information on CAMAC Products and Applications. Readers are also advised to obtain detailed information from manufacturers or their agents in order to check compatibility and operational characteristics of their products.

Remarks on some columns in the Index of Products

Column

NC – N is new, C is corrected entry.

CODE – Classification code, a 2- or 3-digit decimal number (see below).

WIDTH – 1 to 25, indicates module width or—for crates—the number of stations available.
– 0 indicates unknown width or format.
– Blank, the width has no meaning.
– NA indicates other format, normally a 19 inch rack mounted chassis.

NPR – Number in brackets is issue number of the Bulletin in which the item was or is described in the New Products section.

DELIV – Date on which item became or will become available.

CLASSIFICATION GROUPS

INDEX OF PRODUCTS

1 DATA MODULES — I/O TRANSFERS AND PROCESSING

11 Digital Serial Input Modules — Scalers, Time Interval and Bi-directional Counters, Serial Coded etc.

111 Simple Serial Binary Registers

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	1X24 BIT BINARY BLIND SCALER (20MHZ NIM OR 10MHZ TTL I/P,EXT INHIBIT IN,OVF O/P)	J EB 10	SCHLUMBERGER	1	/71	
	MINISCALER (2X16BIT,30MHZ,SEPARATE GATES AND EXTERNAL RESET,NIM LEVELS)	1002	BORER	1	/69	
	MINISCALER (2X16BIT,30MHZ,SEPARATE GATES AND EXTERNAL RESET,NIM LEVELS)	002	NUCL. ENTERPRISES	1		
	MINISCALER(2X16BIT,30MHZ,SEPARATE GATES AND EXT RESET,NIM LEVELS)	C 104	RDT	1	/71	
	DUAL 150 MHZ 16 BIT SCALER (ONE 50 OHMS, ONE UNTERMINATED NIM INPUT PER SCALER)	2S 2024/16	SEN	1	/70	
	DUAL 24 BIT BINARY SCALER (15MHZ, NIM OR TTL INPUTS)	FHC 1313	FRIESEKE	1	/72	
C	DOUBLE SCALER (24/16BIT,50MHZ,2 I/P & 3 GATE MODES,INHIBIT, P1-OVERFLOW)	C-DS-24	WENZEL ELEKTRONIK	1	/72	
	DUAL 150 MHZ 24 BIT SCALER (ONE 50 OHMS, ONE UNTERMINATED NIM INPUT PER SCALER)	2S 2024/24	SEN	1	/70	
	QUAD CAMAC SCALER (4X16BIT OR 2X32BIT, 40MHZ)	1004	BORER	1	/72	
	TIME DIGITIZER (4X16BIT,50MHZ CLOCK,WITH CENTRE FINDER, USABLE WITH PRE-AMP 511)	1005	BORER	1	/72	
	QUAD SCALER TYPE 003 (4X16BIT,50MHZ)	S003	EG&G/ORTEC	1	/73	
	SERIAL REGISTER (4X16BIT,2X32BIT SELECTABLE,25MHZ,COMMON GATE,NIM LEVELS)	SR 1605	GEC-ELLIOTT	1	/71	
	QUAD 40 MHZ SCALER (4X16BIT,2X32BIT SELECTABLE,INDIV HI-Z INHIBITS, NIM)	SR 1606	GEC-ELLIOTT	1	/71	
	MICROSCALER (4X16 BIT,25MHZ,OPTIMIZED INPUT,3 NSEC,GIVES TYP 80MHZ COUNTING)	003-4	NUCL. ENTERPRISES	1	/71	(5)
	MICROSCALER(4X16BIT,2X32BIT SELECTABLE, 25MHZ,COMMON GATE,NIM LEVELS)	C 102	RDT	1	/71	
	4X16 BIT BINARY BLIND SCALER (50 MHZ, 2X32BIT SELECTABLE,COMMON GATE,NIM/TTL)	J EB 20	SCHLUMBERGER	1	/71	
	FOUR-FOLD SCALER (4X16BIT,2X32BIT SELECTABLE,50MHZ,COMMON GATE,NIM LEVELS)	4 S 2003/50	SEN	1	/69	
	FOUR-FOLD CAMAC SCALER (4X16BIT,40MHZ, ONE 50 OHMS,ONE HI-Z NIM I/P PER SCALER)	4 S 2004	SEN	1	/70	
	TIME DIGITIZER(4X16BIT,CLOCK RATE 70/85MHZ, WITH CENTER FINDING LOGIC)	TD 2031	SEN	1	/72	
	TIME DIGITIZER (4X16BIT,CLOCK RATE 70/85MHZ,NIM LEVELS)	TD 2041	SEN	1	/72	(4)
	SERIAL REGISTER (4X16BIT,2X32BIT SELECTABLE,100MHZ,COMMON GATE,NIM LEVELS)	SR 1608	GEC-ELLIOTT	1	/71	
	QUAD 100 MHZ SCALER(4X16/24BIT,-0.5V I/P THRESHOLD,COMMON EXT FAST INHIBIT,NIM)	2550B	LRS-LECROY	1	/70	
	FOUR-FOLD SCALER(4X16BIT,2X32BIT SELECTABLE,100MHZ,COMMON GATE,NIM LEVELS)	4 S 2003/100	SEN	1	/70	
	QUAD SCALER (4X24BIT, 50MHZ, DATAWAY AND/OR EXT FAST INHIBIT, NIM LEVELS)	S424S	EG&G/ORTEC	1		(7)
	QUAD COUNTING REGISTER(4X24BIT,NIM INPUT TTL INHIBIT IN,TTL CARRY AND OVF OUT)	709-2	NUCL. ENTERPRISES	1	/71	
	SCALER (4X24BIT, 50MHZ)	9051	NUCL. ENTERPRISES	1	/73	
	QUAD SCALER (4X24BIT,150/125MHZ,DATAWAY AND/OR EXT FAST INHIBIT,NIM LEVELS)	S424B	EG&G/ORTEC	1	/71	
	QUAD SCALER (4X24BIT, 200MHZ, DATAWAY AND/OR EXT FAST INHIBIT, NIM LEVELS)	S424F	EG&G/ORTEC	1		
	QUAD SCALER (4X24BIT, 125MHZ,INTERRUPT STRUCTURE, INDIVIDUAL INHIBIT INPUTS)	S1	JOERGER	1	/72	(5)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	QUAD SCALER (4X24BIT, 200MHZ,INTERRUPT STRUCTURE, INDIVIDUAL INHIBIT INPUTS)	S1-1	JOERGER	1	/73	
C	QUAD 100MHZ SCALER (4X24BIT,DISCR LEVEL -0.5V,TIME-INTERVAL APPL,NIM INHIB I/F)	85A	JORWAY	1	/71	(2)
	HEX TTL/NIM 50 MHZ SCALER	3610	KINETIC SYSTEMS	1	/73	
	HEX NIM 100 MHZ SCALER	3615	KINETIC SYSTEMS	1	/73	(8)
	OCTAL SCALER (12BITS,8 INPUTS,50MHZ,EACH SCALER GIVES EXT INHIBIT,NIM LEVELS)	S812	EG&G/ORTEC	1	/71	
	TIME DIGITIZER (6 CHANNELS,16 BITS, 100 MHZ CLOCK RATE)	TD	JOERGER	1	08/74	(11)
	12-CHANNEL 16 BIT SCALER (CERN SPS2135)	9054	NUCL. ENTERPRISES	1		(10)
	12-CHANNEL 100 MHZ SCALER(12X24BIT,-0.5V I/P THR, COMMON FAST CLEAR & INHIB, NIM)	2551	LRS-LECROY	1	09/74	
	HEX COUNTING REGISTER (6X24BIT, 100MHZ NIM & TTL LEVELS, TTL CARRY OVF, BIN)	320	HYTEC	1	08/74	

112 Simple Serial Decade Registers

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	1X6 BCD DECADE SCALER (30 MHZ, BUILT-IN DISPLAY)	J EA 20	SCHLUMBERGER	1	/73	
	DUAL 24 BIT BCD SCALER (15MHZ, NIM OR TTL INPUTS)	FHC 1311	FRIESEKE	1	/72	
	DUAL 100 MHZ-6 DECADE BCD SCALER	C 350	INFORMATEK	1	/73	
	2X6 BCD DECADE SCALER - 100 MHZ WITH REMOTE DISPLAY	J EA 10	SCHLUMBERGER	1	/71	
	QUAD BCD SCALER (4X6 DECADES,30MHZ)	9021	NUCL. ENTERPRISES	1	/71	
	HEX COUNTING REGISTER (6X24BIT, 100MHZ NIM & TTL LEVELS, TTL CARRY OVF, BCD)	321	HYTEC	1	08/74	

113 Preset Serial Binary Registers

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	16 BIT PRESETTABLE INTERVAL COUNTER	2201	BI RA SYSTEMS	1	/73	
	PRESET COUNTING REGISTER (16BIT,10MHZ, NIM/TTL I/P,TTL INHIB + O/P,DATAWAY SET)	7039-1	NUCL. ENTERPRISES	1	/70	
	24 BIT PRESETTABLE INTERVAL COUNTER	2202	BI RA SYSTEMS	1	/73	
	PRESET COUNTING REGISTER (24BIT,10MHZ, DATAWAY SET,NIM/TTL INPUT,TTL O/P+INHIB)	703-1	NUCL. ENTERPRISES	1	/71	
	SCALER 50 MHZ (12/16/18/24BIT,PRESET WITH OVF LINE,CONSTANT DEADTIME)	C 72451-A3-A1	SIEMENS	1	/72	
C	PRESET SCALER(24/16BIT,50MHZ,DATAW. SET, BUFFER,2 I/P & 3 GATE MODES,INHIB,OVFLO)	C-PS-24	WENZEL ELEKTRONIK	1	/72	
	DUAL PRESET COUNTING REGISTER(16BIT BIN)	2204	BI RA SYSTEMS	1	/73	
	DUAL PRESET COUNTER/TIMER (2X16/24BIT, 40MHZ MIN, SELF RELOADABLE)	1006	BORER	1	07/74	
	DUAL PRESET SCALER (2X16BIT,5MHZ, NIM FAST LOGIC LEVELS)	PS016	EG&G/ORTEC	1	/73	
	DUAL 50 MHZ SCALER-TIMER (24 BITS)	2101	BI RA SYSTEMS	2	01/74	
	2X24 BIT PRESET SCALER (100MHZ COUNTING)	J EP 30	SCHLUMBERGER	1	/73	
	PRESET QUAD COUNTER (4X24BIT, 75 MHZ, NIM + TTL LEVELS, TTL CARRY OVF, BINARY)	310	HYTEC	1	/73	

114 Preset Serial Decade Registers

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	REAL TIME CLOCK, LIVE TIME INTEGRATOR, PRESET TIMER	RC014	EG&G/ORTEC	1	/73	
	REAL TIME CLOCK (3.8 USEC TO 18.2 HRS, PRESET-TIME AND PRESET-COUNT MODES)	RTC 2014	SEN	1	/71	
	24BIT BCD PRESET-SCALER (12MHZ, NIM OR TTL INPUTS,MANUAL OR DATAWAY PRESET)	FHC 1301	FRIESEKE	2	/71	(1)
	24BIT BCD PRESET-SCALER (12MHZ, NIM OR TTL INPUTS,DATAWAY PRESET)	FHC 1302	FRIESEKE	1	/71	
	6 BCD DECADE SCALER (MANUAL AND DATAWAY PRESET,1 MHZ, START/STOP OUTPUT)	J EP 20	SCHLUMBERGER	2	/71	
	PRESET SCALER (20MHZ,8DECADE BCD,7 SEGM LED INDICATES CONTENTS AND PRESET NO)	PSR 0801	GEC-ELLIOTT	1	/72	(7)
	PRESET SCALER(10MHZ,8 DECADE BCD,DISPLAY OF 2 SIGNIF NUMBERS+EXP,MAN PRESET,NIM)	C 103	RDT	3	/71	

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	DUAL PRESET COUNTING REGISTER(4 DECADES)	2204	BI RA SYSTEMS	1	/73	
	PRESET QUAD COUNTER (4X24BIT, 75 MHZ, NIM + TTL LEVELS, TTL CARRY OVF, BCD)	311	HYTEC	1	/73	

117 Other Digital Serial Input Modules (Bi-Directional Sequential, Shift Types)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	DEAD TIME COUNTER	2203	BI RA SYSTEMS	1	01/74	
	DUAL INCREMENTAL POSITION ENCODER (2X20 BIT CAPACITY)	PE019	EG&G/ORTEC	1	/73	
	UP/DOWN PRESETTABLE COUNTER(24BIT,10MHZ, GATE AND PULSE BURST OUTPUTS)	S2	JOERGER	1	/72	(5)
	UP/DOWN PRESETTABLE COUNTER(6 BCD DIGITS 10MHZ, MANUAL AND DATAWAY PRESET)	S2-1	JOERGER	1	/73	
	QUAD PRESETTABLE UP-DOWN COUNTER	3640	KINETIC SYSTEMS	1	/73	
	DUAL INCREMENTAL POSITION ENCODER (2X20 BIT X-Y DIGITIZATION BY UP-DOWN COUNTER)	2IPE 2019	SEN	1	/71	

12 Digital Parallel Input Modules — Storing and Non-storing Registers, Coinc. Latch, Lam, Status etc.

121 Non-Storing Registers (Gates)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	PARALLEL INPUT GATE (CERN SPS2133)	9049A	NUCL. ENTERPRISES	1		(10)
C	INPUT GATE (24BIT, SOURCE SELECTION BY 6BIT OUTPUT, DATAWAY GEN STROBE OUT)	J 007	JORWAY	1	/74	(8)
	INPUT GATE 24-BIT	3420	KINETIC SYSTEMS	1	/71	(4)
	PARALLEL INPUT GATE (24BIT STATIC DATA, INTEGRATED FOR 1 USEC,TTL LEVELS)	7059-1	NUCL. ENTERPRISES	1	/70	
	PARALLEL INPUT GATE (22BIT STATIC DATA, 500 NSEC INTEGRATION,STROBE SETS L,TTL)	7060-1	NUCL. ENTERPRISES	1	/70	
	PARALLEL INPUT GATE (24 BIT)	9049B	NUCL. ENTERPRISES	1		(10)
	24-BIT ISOLATED INPUT GATE	3471	KINETIC SYSTEMS	1	/73	
	STATIC DIGITAL INPUT (2X16BIT, TTL)	C 76451-A8-A4	SIEMENS	1	/73	(6)
	DUAL PARALLEL STROBED INPUT GATE(2X24BIT HANDSHAKE MODE TRANSFER TO DATAWAY,TTL)	61	JORWAY	1	/70	
	DUAL PARALLEL INPUT GATE (2X24BIT,NON-INTERLOCK CONTROL TRANSF TO DATAWAY,TTL)	61-1	JORWAY	1	/70	
	INPUT GATE DUAL 24 BIT	3472	KINETIC SYSTEMS	1		
	INPUT GATE (2X24BIT STATIC DATA,INTEGR FOR 1USEC,TTL LEVELS,IN VIA 50-WAY CONN)	320	POLON	1	/73	
	DUAL 24 BIT PARALLEL INPUT GATE (WITH LED DISPLAY OPTION)	PG-604	STND ENGINEERING	1	/72	(6)
	PARALLEL INPUT GATE (3X16BIT INPUT FROM ISOLATING CONTACTS)	1061	BORER	1	/72	(4)
	3X16-BIT INPUT GATE (INPUTS ISOLATED BY OPTO-COUPLERS)	1063	BORER	1	/73	(8)
	DIGITAL INPUT REGISTER WITH OPTO COUPLER (4X8BIT PARALLEL INPUT GATES,WITH L)	DO 200-2003	DORNIER	1	/72	
	(WITH FRONT PANEL CONNECTOR)	DO 200-2203		1	/72	
	PARALLEL INPUT GATE(16X16BIT,TTL, 1=LOW)	IG 25601	GEC-ELLIOTT	2	/72	
	128 BIT RECEIVER (ADDRESSABLE AS 8 16BIT WORDS OR 128 1-BIT WORDS)	C 341	INFORMATEK	1	/73	
	DIGITAL INPUT REGISTER (5X8BIT PARALL INPUT GATES,5TH BYTE SETS L,TTL,1=H)	DO 200-2001	DORNIER	1	/71	
	(WITH FRONT PANEL CONNECTOR)	DO 200-2201		1	/72	
	(WITHOUT WIRING BOARD)	DO 200-2000		1	/73	
	DIGITAL INPUT REGISTER (5X8BIT PARALL INPUT GATES,5TH BYTE SETS L,HLL,1=H)	DO 200-2002	DORNIER	1	/72	
	(WITH FRONT PANEL CONNECTOR)	DO 200-2202		1	/72	

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR

122 Storing Registers

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	OPTICAL ISOLATED INPUT REGISTER	2501	BI RA SYSTEMS	1	/74	
	INPUT REGISTER (24 INPUTS, + STROBE, OPTICALLY ISOLATED)	IR-2	JOERGER	1	06/74	(11)
	DYNAMIC DIGITAL INPUT, POT. FREE	C 76451-A17-A3	SIEMENS	1	/73	(6)
	PARALLEL-INPUT-REGISTER (SINGLE 16/24BIT OPT,READY SIGNALS,I/O TTL,CONTROL BUS)	MS PI 2 1230/1	AEG-TELEFUNKEN	1	/70	(1)
	PARALLEL INPUT REGISTER (16BIT,CONTINU-OUS OR STROBED MODES CONTROLLED BY REG)	7014-1	NUCL. ENTERPRISES	1	/70	
	DYN. DIG. INPUT (16BIT, TTL, LAM IF INPUT 0-1 OR 1-0 OR BOTH)	C 76451-A17-A4	SIEMENS	1	/73	(6)
	INPUT REGISTER (24BIT, SPEC CONN, 8 BIT	FHC 1308	FRIESEKE	0	/71	
	INPUT REGISTER 24-BIT	3470	KINETIC SYSTEMS	1	/71	(4)
	BALANCED INPUT REGISTER WITH ADDRESSING	3430	KINETIC SYSTEMS	1	/72	(8)
	PARALLEL INPUT REGISTER (2X16BIT, TTL)	2312	BI RA SYSTEMS	1	/73	
	DUAL INPUT REGISTER(2X16BIT,LAM & STROBE I/P & DATA-READ-STROBE O/P PER CHANNEL)	PR 1610 SERIES	GEC-ELLIOTT	1	/73	
	CAMAC UNTERM. I/P'S VIA SCHMITT TRIGGERS I/P FILTER RESPONSE 1USEC TO 10MS	PR 1611		1		
	DUAL 16 BIT INPUT REGISTER (TTL LEVELS, CERN SPECS 072)	2IR 2002	SEN	1	/72	
	DUAL 16 BIT INPUT REGISTER(EXT STROBE OR DATAWAY COMMAND STORES DATA,TTL LEVELS)	2IR 2010	SEN	1	/70	
	DIGITAL INPUT (2X16BIT POT. FREE)	C 76451-A8-A3	SIEMENS	1	/73	(6)
	DUAL 24 BIT PARALLEL INPUT REGISTER(TTL)	2322	BI RA SYSTEMS	1	/73	
	DUAL 24 BIT INPUT REGISTER (TTL, HANDSHAKE)	RI-224	EG&G/ORTEC	1	/72	
	DUAL INPUT REGISTER(2X24BIT,LAM & STROBE I/P & DATA-READ-STROBE O/P PER CHANNEL)	PR 2400 SERIES	GEC-ELLIOTT	1	/73	
	CAMAC UNTERM. I/P'S VIA SCHMITT TRIGGERS I/P FILTER RESPONSE 1USEC TO 10MS	PR 2401		1	/73	
	(SAME BUT WITH TWISTED PAIR INPUTS)	PR 2402		1	/73	
	(SAME BUT WITH OPTICAL ISOLATION INPUT, LOGIC 1 = 5V OR 12MA)	PR 2403		1	/73	
C	DUAL PARALLEL INPUT REGISTER(2X24BIT,EXT LOAD REQUEST,4 OPER MODES,TTL LEVELS)	60A	JORWAY	1	/70	
	24-BIT DUAL PARALLEL INPUT REGISTER (A HAS LO-Z, B HAS UNTERMINATED INPUT)	9041A/9041B	NUCL. ENTERPRISES	1	/72	(7)
	PARALLEL INPUT REGISTER (2X24 BITS)	J RE 10	SCHLUMBERGER	1	/73	(7)
	DUAL 24 BIT PARALLEL INPUT REGISTER (WITH LED DISPLAY OPTION)	PR-604	STND ENGINEERING	1	/72	
	DUAL INPUT REGISTER (2X24BIT,I/P INTEGR TTL, FULL LAM, OUTPUT STROBES)	220	HYTEC	1	/73	
	INPUT REGISTER (2X24BIT, 3 MODES OF DATA ENTRY, LED DISPLAY)	IR	JOERGER	1	/72	(7)
	DIGITAL INPUT REGISTER, EXTERNAL STROBE (4X8BIT INPUT LATCHES, 1X8BIT SET LAM)	DO 200-2004	DORNIER	1	/73	
	(SAME WITH FRONT PANEL CONNECTOR)	DO 200-2204		1	/73	

123 Terminated Signal Input Registers (Coinc. Latch, Pattern etc.)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	COINCIDENCE LATCH (24 NIM INPUTS WITH COMMON STROBE, EXT RESET, 2NSEC OVERLAP)	C124	EG&G/ORTEC	2		
	12 BIT PARALLEL INPUT REGISTER (NIM)	2351	BI RA SYSTEMS	1	/73	
	INTERRUPT REGISTER 12-INPUT & STROBE NIM FAST LOGIC LEVELS	IR026	EG&G/ORTEC	1	/73	
	STROBED INPUT REGISTER (12BIT COINC AND LATCH,NIM LEVELS,PATTERN AND L-REQ APPL)	SIR 2026	SEN	1	/70	
	FAST COINCIDENCE LATCH(16BIT,DISCR I/F, MIN 2 NSEC STROBE-SIGNAL OVERLAP)	64	JORWAY	1	/71	(1)
	16 FOLD DCR (16 DISCR, COMMON STROBE, -70MV THRESHOLD, FAST SUMMING OUTPUTS)	2340B	LRS-LECROY	2	/71	(6)
C	16-CH COINCIDENCE REGISTER (STROBE I/P, 2NS OVERLAP,FAST SUM O/P AND CLEAR,NIM)	2341S	LRS-LECROY	1	/71	(4)
	PATTERN UNIT (16 INDIV NIM INPUTS,COMMON NIM GATE)	021	NUCL. ENTERPRISES	2	/71	(5)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	FAST INPUT REGISTER (ASSEMBLES 16BIT WORDS FROM IL2 INPUTS)	9053	NUCL. ENTERPRISES	1	06/74	
	PATTERN UNIT(16BIT,I/P STROBED WITH COMMON GATE,10 NSEC OVERLAP,NIM LEVELS)	C 101	RDT	2	/71	
	16 BIT PATTERN UNIT (NIM I/P AND GATE)	J PU 10	SCHLUMBERGER	1	/72	
	PATTERN UNIT 16 BIT (16 INDIVIDUAL NIM INPUTS,COMMON NIM GATE, CERN SPECS 021)	16P 2007	SEN	2	/70	
	16 BIT PATTERN UNIT (CERN 071, 16 INDIV NIM INPUTS,COMMON NIM GATE,LED DISPLAY)	16P 2047	SEN	1	/72	(11)
	COINCIDENCE BUFFER (2X12BIT,ONE STROBE PER 12BITS,MIN 2NS OVERLAP,NIM INPUTS)	C212	EG&G/ORTEC	2	/71	

124 Manual Input Modules (Word Generators, Parameter Units)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	WORD GENERATOR (SWITCH REGISTER,12BIT)	WG005	EG&G/ORTEC	1	/73	
	PARAMETER UNIT 12 BIT (PROVIDES 12 BIT COMMUNICATION,PUSH BUTTON L-REQUEST)	P 2005	SEN	1	/70	
	MANUAL INPUT REGISTER (INPUTS A HAND-SET 16-BIT WORD, MANUAL AND ELECTR LAM I/F)	1041	BORER	1	/73	(8)
	DATA SWITCHES (16/24 BITS,READABLE + CONTENT ADDR)	C 322	INFORMATEK	1	/72	
	24 BIT PARAMETER UNIT	2501	BI RA SYSTEMS	1	/73	
	WORD GENERATOR (24BIT WORD MANUALLY SET BY SWITCHES)	WG 2401	GEC-ELLIOTT	1	/71	
N	MANUAL INPUT/OUTPUT REGISTER (24 BITS, SWITCH I/F + LAM, 24 LED O/P REGISTER)	201	JORWAY	1	/74	(11)
	24-BIT MANUAL INPUT	3460	KINETIC SYSTEMS	1	/73	
	WORD GENERATOR (24 BITS OF BINARY DATA, SWITCH SELECTED)	9020	NUCL. ENTERPRISES	1	/71	(2)
	24 BIT WORD GENERATOR , WITH LAM	WGP-241	STND ENGINEERING	1	/73	
	PARAMETER UNIT (QUAD 4-DECADE BCD PARAMETERS MANUALLY SET)	022	NUCL. ENTERPRISES	4	/71	(2)
	PARAMETER UNIT (QUAD 4 DECADE BCD PARAMETERS MANUALLY SET)	C 105	RDT	4	/71	

127 Other Parallel Input Modules (Incl. Lam and Status Registers, See 232 for FLam Grader)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	24-BIT INTERRUPT REGISTER (STATUS COMPARED,CHANGE GIVES LAM)	1051	BORER	1	/72	(3)
C	PRIORITY INPUT REGISTER(12BITS ORED TO LAM,FAST COINC LATCH APPL,MASK REGISTER)	63	JORWAY	2	/70	
N	INPUT REGISTER (12 BIT, ORED TO LAM, COINCIDENCE LATCH APPL, NIM INPUTS)	65	JORWAY	1	/74	
	INTERRUPT REQUEST REGISTER (8BIT, TTL INPUTS TO REGISTER,ANY INPUT GIVES LAM.	7013-1	NUCL. ENTERPRISES	1	/70	
	INTERRUPT REQUEST REGISTER	EC 218	NUCL. ENTERPRISES	1		
	LAM REQUEST REGISTER (16 BIT)	300	POLON	1	02/74	
N	INTERRUPT ALARM REGISTER (16 BITS, INDIVIDUALLY MASKABLE)	J IR 10	SCHLUMBERGER	1	/74	(11)
	64 LINE SURVEYOR (SINGLE OR CONTINUOUS SURVEY CYCLES, 3 SURVEY MODES)	64LS 2052	SEN	1		(9)
N	STATUS INTERRUPT (24BIT,I/P&LATCH&LAM& MASK,GROUP&SEL-LAM-TEST,VAR.LOGIC&LEVEL)	C-SI-24	WENZEL ELEKTRONIK	1	/74	

13 Digital Output Modules — Serial: Clocks, Timers, Pulse Generators, Parallel: TTL Output, Drivers

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	~~OPTICAL ISOLATED OUTPUT REGISTER~~	~~3601~~	~~BI RA SYSTEMS~~	~~1~~	~~/74~~	

131 Serial Output Modules (Clocks, Timers, Pulse Gen.)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	PRESET SCALER (LEVEL OR PULSE TRAIN O/P, DURATION SET BY COMMAND,SINGLE & REPEAT)	PSR 0801	GEC-ELLIOTT	1	/73	
N	GATED CLOCK (10MHZ TO 1HZ, INT-EXT CLOCK, SYNCHRONOUS GATING)	217	JORWAY	1	/74	(11)
	TIMER MODULE	3655	KINETIC SYSTEMS	1	/73	
	REAL TIME CLOCK	9064	NUCL. ENTERPRISES	1		(10)
	CRYSTAL CLOCK GENERATOR (7 TTL OUTPUTS FOR 1HZ TO 1MHZ FREQUENCY DECADES)	FHC 1303	FRIESEKE	1	/71	(1)
	CRYSTAL CONTROLLED PULSE GENERATOR(7 DE-CADES-1HZ TO 1MHZ-500NS PULSES OUT,TTL)	PG 0001	GEC-ELLIOTT	1	/71	
	REAL TIME CLOCK (4SEC CLOCK/5MSEC STOP WATCH)	C 320	INFORMATEK	1	/72	
	CLOCK GENERATOR (INT 10MHZ, EXT 50MHZ, 8 DECADE STEPS,PLUS PROGRAMMABLE OUTPUT)	CG	JOERGER	1	/72	(7)
	CLOCK PULSE GENERATOR (7 OUTPUTS-1HZ TO 1MHZ-IN DECADE STEPS,10MHZ EXT IN,TTL)	7010-1	NUCL. ENTERPRISES	1	/70	
	CLOCK PULSE GENERATOR(7 DECADES-1HZ TO 1MHZ-500 NSEC PULSES OUT,TTL AND NIM)	C 109	RDT	1	/71	
	1 HZ - 1 MHZ QUARTZ CLOCK (7 O/P - 1HZ TO 1MHZ-200 TO 800 NSEC WIDTH,TTL LEVEL)	J HQ 10	SCHLUMBERGER	1	/71	
	QUARZ-CLOCK WITH 2 TIMER FUNCTIONS	C 76451-A14-A1	SIEMENS	1	/72	
	CAMAC-CLOCK-GENERATOR(7 DECADES-10MHZ TO 1HZ,50/500 NSEC O/P PULSES,2.8V/50 OHMS)	C-CG-10	WENZEL ELEKTRONIK	1	/71	
	CLOCK/TIMER (0.001S TO 10 HRS TIME INTERVAL,REAL-TIME OUTPUT)	1411	BORER	1	/72	(3)
	REAL TIME CLOCK, LIVE TIME INTEGRATOR, PRESET TIMER	RC014	EG&G/ORTEC	1	/73	
	REAL TIME CLOCK (COUNTS .1 SEC TO 999 DAYS, DISPLAYS HRS/MIN/SEC, 50/60HZ GEN)	RTC	JOERGER	2	/73	(7)
	REAL TIME CLOCK (3.8 USEC TO 18.2 HRS, PRESET-TIME AND PRESET-COUNT MODES)	RTC 2014	SEN	1	/71	
	TIME BASE (10 TO 100MHZ IN INCREMENTS OF 10MHZ, USED WITH TD 2031/TD 2041)	TB 2032	SEN	1	/71	
	TIMER (MIN 1USEC,OVF FROM COUNTER-PP1)	C 76451-A12-A1	SIEMENS	2	/73	(6)
	TEST PULSE GENERATOR (5 TO 50 NSEC NIM O/P PULSE DERIVED FROM S1.F(25) OR EXT)	TPG 0202	GEC-ELLIOTT	1	/71	
N	8 CHANNEL DELAY GENERATOR (DELAY 0 TO 99 TIMES CLOCK, DELAYS CASCADABLE)	220	JORWAY	1	/74	(11)
	DUAL PROGRAMMED PULSE GENERATOR(50HZ/2KHZ/5MHZ PULSE TRAIN,LENGTH BY COMMAND)	2PPG 2016	SEN	1	/71	

132 Parallel Output Registers (TTL, HTL, NIM etc.)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	12 BIT PARALLEL OUTPUT REGISTER (NIM)	3251	BI RA SYSTEMS	1	/73	
	NIM FAST LOGIC DRIVER (12 OUTPUTS)	ND027	EG&G/ORTEC	1	/73	
	12 BIT OUTPUT REGISTER(DC OR PULSE O/P, UPDATING STROBE OUTPUT,NIM LEVELS)	41	JORWAY	1	/71	(2)
	OUTPUT REGISTER (12BIT, NIM PULSES OR LEVELS OUT)	OR 2027	SEN	1	/70	
	DIFFERENTIAL OUTPUT REGISTER	3030	KINETIC SYSTEMS	1	/72	(8)
	OUTPUT REGISTER (24BIT TTL VIA SPEC CONN	FHC 1309	FRIESEKE	0	/72	
	OUTPUT REGISTER	351	POLON	1	/73	
C	PARALLEL OUTPUT REG. (24BIT,NEG/OPT POS TTL,ADJ. DURATION&LEVEL,4 TIMING MODES)	C-OC-24	WENZEL ELEKTRONIK	1	/73	(10)
	DUAL 16BIT PARALLEL OUTPUT REGISTER(TTL)	3212	BI RA SYSTEMS	1	/73	
	DUAL 16 BIT OUTPUT REGISTER (SELECTABLE O/P STAGES ON PLUGABLE PC, FP CONNECTOR)	2OR 2051	SEN	1		(9)
	DUAL 24 BIT PARALLEL OUTPUT REGISTER	3222	BI RA SYSTEMS	1	/73	
	OUTPUT REGISTER (2X24BIT DATA OUT,DATA-READY + BUSY FORM HANDSHAKE, TTL)	RO-224	EG&G/ORTEC	1	/72	
	OUTPUT REGISTER (2X24BIT OR 6X8BIT, LED DISPLAY)	OR	JOERGER	1	/72	(7)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	24-BIT DUAL OUTPUT REGISTER	9042	NUCL. ENTERPRISES	1	/72	(7)
	DUAL OUTPUT REGISTER (2X24BIT, DATAWAY READ AND WRITE, HANDSHAKE CONTROL, LO-Z)	9043A	NUCL. ENTERPRISES	1		(7)
	DUAL OUTPUT REGISTER (2X24BIT, DATAWAY READ AND WRITE, HANDSHAKE CONTROL, HI-Z)	9043B		1		(7)
	PARALLEL OUTPUT REGISTER (2X24 BITS)	J RS 10	SCHLUMBERGER	1	/73	(7)
	DUAL 24 BIT PARALLEL OUTPUT REGISTER (WITH LED DISPLAY OPTION)	PR-612	STND ENGINEERING	1	/71	(6)
	DIGITAL OUTPUT REGISTER (4X8BIT PARALL OUTPUT REGISTER,NO L,TTL,1=H)	DO 200-2501	DORNIER	1	/71	
	(WITH FRONT PANEL CONNECTOR)	DO 200-2701		1	/72	
	(WITHOUT WIRING BOARD)	DO 200-2500		1	/73	
	DIGITAL OUTPUT REGISTER (4X8BIT PARALL OUPTPUT REGISTER, HLL 12V)	DO 200-2505	DORNIER	1	/73	
	(WITH FRONT PANEL CONNECTOR)	DO 200-2705		1	/73	
	DIGITAL OUTPUT REGISTER (4X8BIT PARALL OUPTPUT REGISTER, HLL 12V,INVERTING)	DO 200-2506		1	/73	
	(WITH FRONT PANEL CONNECTOR)	DO 200-2706		1	/73	
	DIGITAL OUTPUT REGISTER (4X8BIT PARALL OUPTPUT REGISTER, HLL 24V)	DO 200-2507		1	/73	
	(WITH FRONT PANEL CONNECTOR)	DO 200-2707		1	/73	
	DIGITAL OUTPUT REGISTER (4X8BIT PARALL OUPTPUT REGISTER, HLL 24V, INVERTING)	DO 200-2508		1	/73	
	(WITH FRONT PANEL CONNECTOR)	DO 200-2708		1	/73	
	BUFFER STORE/REGISTER (32X24BIT,WITH EXTERNAL ADDRESSING FACILITY)	104	HYTEC	1		
	BUFFER STORE/REGISTER (32X16BIT, WITH EXTERNAL ADDRESSING FACILITY)	105		1		
	(SAME, 16X16BIT, WITHOUT EXT ADDR)	103		1	/73	
	128 BIT OUTPUT REGISTER (ADDRESSABLE AS 8 16BIT OR 128 1-BIT WORDS)	C 342	INFORMATEK	1	/73	

133 Parallel Output Drivers (Open Coll., Relay, etc.)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	TRIAC OUTPUT REGISTER (8 BITS, 2 AMPS, ZERO VOLTAGE SWITCHING)	LT	JOERGER	1	10/74	
	8 BIT TRIAC OUTPUT REGISTER	3080	KINETIC SYSTEMS	1	/73	
	12-BIT OUTPUT REGISTER (WITH OPTICAL ISOLATION,OPEN COLL O/P, MAX 30V/100MA)	3082	KINETIC SYSTEMS	1		
	12-BIT OUTPUT REGISTER WITH ISOLATED RELAY	3087	KINETIC SYSTEMS	1	/71	(4)
	SWITCH (12BIT DATAWAY CONTROLLED RELAY REGISTER FOR SWITCHING AND MULTIPLEXING)	7066-1	NUCL. ENTERPRISES	1	/71	
	DRIVER (16BIT,OPEN COLLECTOR OUTPUT VIA MULTIWAY CONNECTOR,MAX 150MA/LINE)	9002	NUCL. ENTERPRISES	1	/71	
	OUTPUT REGISTER (16BIT WORD, 24V/.1A OUTPUT VIA 25-WAY CONNECTOR)	360	POLON	1	/73	
	RELAY DRIVER (16 WAY RELAY OUTPUT)	J RD 10	SCHLUMBERGER	1	/73	(8)
C	PARALLEL OUTPUT REGISTER (16BIT REED RE-LAY,MAX SWITCHED PWR 10W,4 TIMING MODES)	C-OR-16	WENZEL ELEKTRONIK	1	/72	(10)
	DRIVER (24BIT OUTPUT REGISTER,SET AND READ BY COMMAND,24BIT I/P DATA ACCEPTED)	9013	NUCL. ENTERPRISES	1	/71	
	DRIVER (24BIT OUTPUT REGISTER,SET AND READ BY COMMAND,24BIT I/P DATA ACCEPTED)	9017	NUCL. ENTERPRISES	1	/71	(1)
	OUTPUT REGISTER (2X16BIT,OPEN COLLECTOR)	1084	BORER	1	06/74	
	OUTPUT DRIVER(2X16BIT,40MA SINKING,1=LO, DATAWAY READ & WRITE,LAM I/P,STROBE O/P)	OD 1613	GEC-ELLIOTT	1	/72	
	(SAME, 1=HI)	OD 1614		1	/72	
	OUTPUT DRIVER(2X16BIT,125MA SINKING,1=LO DATAWAY READ & WRITE,LAM I/P,STROBE O/P)	OD 1617	GEC-ELLIOTT	1	/72	
	(SAME, 1=HI)	OD 1618		1	/72	
	OUTPUT DRIVER(2X16BIT,TOTEMPOLE,30 LOADS DATAWAY READ & WRITE,LAM I/P,STROBE O/P)	OD 1620	GEC-ELLIOTT	1	/72	
N	2X16 OR 4X8 BIT OUTPUR REGISTER	J RS 30	SCHLUMBERGER	1	/74	(11)
	DUAL 16 BIT OUTPUT REGISTER (TTL LEVELS, OPEN COLL OUTPUTS VIA CABLE)	20R 2008	SEN	1	/70	
	DUAL OUTPUT DRIVER (200MA SINKING,24V)	20R 2051HC	SEN	1		(9)
	DUAL OUTPUT DRIVER (HI VOLTAGE DRIVER)	20R 2051HV	SEN	1		(9)
	DIGITAL OUTPUT (2X16BIT, MAX 30V)	C 76451-A9-A4	SIEMENS	1	/73	(6)
	OUTPUT REGISTER (2X16BIT VIA ISOLATING CONTACTS)	1082	BORER	1	/72	(4)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	DIGITAL OUTPUT (2X16BIT RELAYS)	C 76451-A9-A3	SIEMENS	1	/73	(6)
	PARALLEL-OUTPUT-REGISTER (DUAL 24BIT, OR QUAD 12BIT,OPEN COLLECTOR OUTPUT)	MS PO 1 1230/1	AEG-TELEFUNKEN	1	/70	(1)
	PARALLEL-OUTPUT REGISTER (24BIT, OPEN COLLECTOR OUTPUT, HANDSHAKE FACILITY)	MS PO 2 1230/1	AEG-TELEFUNKEN	1	/72	(4)
	OUTPUT DRIVER(2X24BIT,40MA SINKING,1=LO, DATAWAY READ & WRITE,LAM I/P,STROBE O/P)	OD 2403	GEC-ELLIOTT	1	/72	
	(SAME, 1=HI)	OD 2404		1	/72	
	OUTPUT DRIVER(2X16BIT,125MA SINKING,1=LO DATAWAY READ & WRITE,LAM I/P,STROBE O/P)	OD 2407	GEC-ELLIOTT	1	/72	
	(SAME, 1=HI)	OD 2408		1	/72	
	OUTPUT DRIVER(2X16BIT,TOTEMPOLE,30 LOADS DATAWAY READ & WRITE,LAM I/P,STROBE O/P)	OD 2410	GEC-ELLIOTT	1	/72	
	DUAL OUTPUT REGISTER (2X24BIT, OPEN COLL O/P, FULL LAM, OUTPUT STROBES)	200-2	HYTEC	1	/73	
	OUTPUT REGISTER (2X24BIT OR 6X8BIT, 250MA SINKING, DIODE CLAMPED)	OR-1	JOERGER	1	/73	
	DUAL 24 BIT OUTPUT REGISTER(DC OR PULSE O/P,UPDATING O/P STROBE,TTL OPEN COLL)	40	JORWAY	1	/71	(2)
N	DUAL 24 BIT OUTPUT REGISTER (DC OR PULSE O/P UPDATING, 300MA SINK, DIODE CLAMPED)	40-2	JORWAY	1	/74	
	DUAL 24-BIT OUTPUT REGISTER (OPEN COLL DRIVERS, MAX 24V OR 250MA, REAR OUTPUTS)	3072	KINETIC SYSTEMS	1		
	DIGITAL OUTPUT REGISTER (4X8BIT PARALL OUTPUT REGISTER,NO L,OPEN COLL O/P,1=H)	DO 200-2502	DORNIER	1	/72	
	(WITH FRONT PANEL CONNECTOR)	DO 200-2702		1	/72	
	DIGITAL OUTPUT REGISTER (4X8BIT PARALL OUTPUT REGISTER,NO L,OPEN COLL O/P,1=L)	DO 200-2503	DORNIER	1	/72	
	(WITH FRONT PANEL CONNECTOR)	DO 200-2703		1	/72	
	DIGITAL OUTPUT REGISTER WITH REED RELAYS (4X8BIT OUTPUT REG,OPEN CONTACT=0)	DO 200-2504	DORNIER	1	/71	
	(WITH FRONT PANEL CONNECTOR)	DO 200-2704		1	/71	

14 Digital I/O, Peripheral and Instrumentation Interfacing modules — Serial and Parallel I/O Regs, Printer-, Tape-, DVM-, Plotter- and Analyser Interfaces, Step-Motor Drivers, Supply CTR, Displays

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	SERIAL INPUT/OUTPUT REGISTER 16BIT CODED	9063	NUCL. ENTERPRISES	1	11/74	

142 Parallel I/O Registers (General Purpose)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	UNIVERSAL INPUT/OUTPUT REGISTER (36BIT DATA+RANGE IN,12BIT REG O/P FOR CONTROL)	1031	BORER	1	/72	(3)
N	UNIVERSAL INPUT/OUTPUT REGISTER	SPS 2090	NUCL. ENTERPRISES	1	01/75	
	15 BIT PARALLEL OUTPUT REGISTER (BIT ADDRESSABLE, NIM LEVELS OR PULSES)	C 343	INFORMATEK	1	/73	
	16 BIT INPUT/OUTPUT REGISTER (O/P STAGES ON PLUGABLE PC, FP CONNECTOR)	IOR 2053	SEN	1	04/74	(11)
	INPUT/OUTPUT REGISTER (24 BITS IN, 12 BITS OUT, OPTICALLY COUPLED)	IOR-1	JOERGER	1	05/74	(11)
	DUAL INPUT DUAL OUTPUT REGISTER (16BIT, TTL IN, OPEN COLL TTL OUT, MAX 40MA,30V)	C110	RDT	1	/72	
	INPUT/OUTPUT REGISTER(2X24BIT IN,2X12BIT OUT, 3 ENTRY MODES, LED DISPLAY)	IR-1	JOERGER	1	/72	(7)
	(SAME, 32X24BIT, WITHOUT EXT ADDR)	100	HYTEC	1		
	(SAME, 32X16BIT, WITHOUT EXT ADDR)	101		1	/72	
	(SAME, 16X24BIT, WITHOUT EXT ADDR)	102	HYTEC	1	/72	

143 Peripheral Interfacing Modules (For TTY, Tape etc.)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	DESK CALCULATOR CTRL (DIFFL INTERFACE TO FHC 1301/02/11 AND FHC 1309)	FHC 1312	FRIESEKE	1	/72	
	TYPEWRITER DRIVE UNIT	TD 0801	GEC-ELLIOTT	2	/73	(1)
N	INTERFACE FOR ASR33 TTY,SERIAL DATA LINK	5711	BI RA SYSTEMS	1	/74	
	TELETYPE C/P CTRL (10 FHC 1301/02/11 AND FHC 1309 VIA SPEC CONN,TTY MOTOR ON/OFF)	FHC 1307	FRIESEKE	1	/71	
	TELETYPE INTERFACE	90	JORWAY	2	/71	
	TELETYPEWRITER INTERFACE(I/O DATA TRANSF AND CONTROL,LAM USED AS TWO-WAY FLAG)	7061-1	NUCL. ENTERPRISES	1	/70	(1)
	TELETYPE INTERFACE (FOR ASR 33)	500	POLON	1	02/74	
	TERMINAL DRIVER	J TY 20	SCHLUMBERGER	1	/73	(11)
	VERSATEC LINE PRINTER INTERFACE	3320	KINETIC SYSTEMS	1	/72	
	PAPER TAPE PUNCH OUTPUT DRIVER (FOR FACIT 4070)	TP 0801	GEC-ELLIOTT	1	/73	(1)
	TAPE READER INTERFACE UNIT (FOR ELECTROGRAPHIC READER)	TR 0801	GEC-ELLIOTT	1	/73	(1)
C	MAG TAPE DRIVER(9-TRACK NRZI COMPATIBLE 1 TO 4K 8-BIT DATA BUFFER)	308.100	EDS SYSTEMTECHNIK	3	11/74	
	MAGNETIC TAPE INTERFACE (TAPE DECKS OR CASSETTES)	CS 0042	NUCL. ENTERPRISES	1	/73	(8)
N	CASSETTE INTERFACE (READS & WRITES BY 8 OR 16BIT WORDS, 8BIT LAM REG) CONTROLS--	J CK 10	SCHLUMBERGER	1	/75	
N	CASSETTE DRIVER FOR 1 CASSETTE	C CK 10			/75	
N	CASSETTE DRIVER FOR 2 CASSETTES	C CK 11			/75	
N	PORTABLE CASSETTE DRIVER(FOR 1 CASSETTE)	P CK 10	SCHLUMBERGER		/75	
	UNIVERSAL ASYNCHRONOUS TRANSMITTER/RECEIVER (129 CHAR.BUFFER)	C 317	INFORMATEK	1	/73	
	B.S.INTERFACE READER (8BIT DATA + PARITY BIT,BRITISH STANDARD)	7057-1	NUCL. ENTERPRISES	1	/71	
	B.S.INTERFACE DRIVER (8BIT DATA + PARITY BIT,BRITISH STANDARD)	7056-1	NUCL. ENTERPRISES	1	/71	(1)
	PERIPHERAL READER(8BIT PARALLEL DATA IN, NEG OR POS TTL,HANDSHAKE CONTROLS)	7064-1	NUCL. ENTERPRISES	1	/71	(1)
	PERIPHERAL DRIVER (8BIT DATA OUT,NEG OR POS TTL,HANDSHAKE CONTROLS)	7065-1	NUCL. ENTERPRISES	1	/71	(1)

144 Display Modules, Display and Plotter Interfacing

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	24 BIT LED BCD DISPLAY (ONE FHC 1301/02/11 VIA SPEC CONNECTOR)	FHC 1305	FRIESEKE	1	/71	(1)
	24 BIT NIXIE BCD DISPLAY (SELECTS ONE OF 10 FHC 1301/02/11 VIA SPEC CONNECTION)	FHC 1306	FRIESEKE	2	/71	(1)
	24 BIT LED BINARY DISPLAY (ONE FHC 1313 OR FHC 1309 VIA SPECIAL CONNECTION)	FHC 1315	FRIESEKE	1	/72	
	DECIMAL DISPLAY UNIT (ADDRESS AND 5 DATA DECADES + MULTIPLIER DISPLAYED)	9007	NUCL. ENTERPRISES	NA	/71	
	DISPLAY CONTROLLER (FOR 9007,INCLUDES BIN TO DECIMAL CONVERTER)	9006		2	/71	
	INDICATOR (1X16BIT OR 2X8BIT,INDICATES STATE OF REGISTER LOADED FROM DATAWAY)	9014	NUCL. ENTERPRISES	1	/71	
	EXTERNAL DISPLAY FOR J EA 10 SCALER	C AF 10	SCHLUMBERGER	NA	/73	
	SCALER DISPLAY THROUGH COMPUTER (DISPLAY OF 24BIT WORD, 30MHZ)	J AF 15	SCHLUMBERGER	2	/71	
	MANUAL BINARY DISPLAY (CONTENT OF A REGISTER DISPLAYED,EXT MULTIWAY CONN)	J AF 20	SCHLUMBERGER	1	/71	
C	GRAPHIC DISPLAY DRIVER FOR HP1311/TEK604	4301	BI RA SYSTEMS	1	01/74	
N	GRAPHIC DISPLAY DRIVER FOR STORAGE DISPLAY TEK 602	4301A	BI RA SYSTEMS	2	04/74	
C	TV DISPLAY DRIVER (12 LINES,40 CHAR/LINE 64 CHARACTER SET, 5X7 DOT MATRIX)	556.200CS	EDS SYSTEMTECHNIK	2	10/74	
C	TERMINAL MODULE (24 LINES, 80 CHAR/LINE 96 CHARACTER SET, 5X7 DOT MATRIX)	556.300CS	EDS SYSTEMTECHNIK	3	10/74	

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	DISPLAY POINT PLOTTER (1024X1024 CAPACITY)	PP012	EG&G/ORTEC	1	/73	
	DISPLAY DRIVER (INTERFACE FOR TEKTRONIX STORAGE OSCILLOSCOPES)	DD015		1	/73	
	CHARACTER GENERATOR (63 CHARACTERS, 7X5 DOTMATRIX, 2 SIZES)	CG018		1	/73	
	DISPLAY VECTOR GENERATOR	VG028		1	/73	
	DISPLAY DRIVER (POINTPLOT CHAR GEN AND VECTOR GENERATOR)	DD 1601	GEC-ELLIOTT	2	/73	(7)
	CRT DECIMAL DISPLAY SYSTEM (INCLUDING)	72A	JORWAY	NA	/71	(2)
	DISPLAY DRIVER	72A		5		
	DISPLAY SYSTEM COMPRISING		KINETIC SYSTEMS		/71	(4)
	DISPLAY SYNCHRONIZING	3200		1	/71	
	DISPLAY TIMING	3205		1	/71	
	DISPLAY CONTROL	3210		1	/71	
	DISPLAY REFRESH (ALPHANUMERIC + GRAPHS)	3212		1	/71	
	DUAL LIGHT PEN INTERFACE	3225		1	/72	
	COLOR MONITOR	RGD 1200 M			/71	
	STORAGE DISPLAY DRIVER	3260	KINETIC SYSTEMS	1	/72	
	DISPLAY DRIVER (TWO 10BIT DAC,OUTPUT RANGE +5V TO -5V,TWO OPERATION MODES)	7011-2	NUCL. ENTERPRISES	2	/70	(1)
	STORAGE OSCILLOSCOPE (DRIVER FOR TEKTRONIX 611 OR 601,USED WITH 7011)	9028	NUCL. ENTERPRISES	1	/71	(2)
	SCOPE DISPLAY DRIVER	J DD 10	SCHLUMBERGER	2	/73	(7)
	MANUAL CONTROL OF J DD 10	MC 10		NA		
	SCOPE DISPLAY DRIVER X-Y-Z (SYSTEM)	FDD 2012	SEN	1	/71	(1)
	STORAGE DISPLAY DRIVER FOR TEKTRONIX 611 OR 601	SDD 2015		1	/71	(1)
	CHARACTER GENERATOR	CG 2018		1	/71	(1)
	VECTOR GENERATOR	VG 2028		1	/71	(1)
	LIGHT PEN FOR FDD 2012 OR CG 2018	LP 2035			/71	
	PLOTTER DRIVER	J XY 10	SCHLUMBERGER	1	/73	(8)

145 Instrumentation Interfacing Modules (DVM, Supply CTR, Stepping Moter Drivers, Pulse Analyser CTR)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	DUAL 15 CHANNEL SERIAL OUTPUT MODULE (STEPPER MOTOR CONTROLLER, TTL)	3101	BI RA SYSTEMS	2	/73	
	STEP MOTOR DRIVER (MAX 32768 STEPS,RATE, ROTATION AND START/STOP FULLY COMMANDED)	1161	BORER	1	/72	(3)
N	STEPPING MOTOR CONTROLLER & DRIVER (ADJUSTABLE ACCEL/DECEL,TIME & MAX FREQ)	SMC	JOERGER	1	09/74	
	STEPPING MOTOR CONTROLLER, DUAL	3360	KINETIC SYSTEMS	1	/72	(4)
	STEPPING MOTOR CONTROLLER	3361	KINETIC SYSTEMS	1	/73	
	STEPPING MOTOR DRIVER (USED WITH 7045)	0709	NUCL. ENTERPRISES	1	/71	
	DELAYED PULSE GENERATOR (4 TTL O/P,0.042 HZ-40KHZ RATE,LEVEL AND DIRECTION CONTR)	7045-1	NUCL. ENTERPRISES	1	/70	
	STEPPING MOTOR DRIVER	J CP 20	SCHLUMBERGER	1	/74	(9)
N	SUPPLY FOR J CP 20	C AMP 10			/74	
C	CONTINUOUS STEPPER CONTROL (65536 STEPS, POSITION/DIRECT./SPEED/ACCELER. CONTROL)	C-ST-4	WENZEL ELEKTRONIK	2	/72	
C	INCREMENTAL STEPPER CONTROL(65536 STEPS, POSITION/DIRECT./SPEED/ACCELER. CONTROL)	C-ST-4-I	WENZEL ELEKTRONIK	2	/72	
N	VARIABLE PULSE DURATION TRIAC OUTPUT MODULE	3701	BI RA SYSTEMS	2	/74	
N	TRIAC OUTPUT REGISTER (8 BITS, 2 AMPS, ZERO VOLTAGE SWITCHING)	LT	JOERGER	1	10/74	
	POWER SUPPLY CONTROLLER 12-BIT	3158	KINETIC SYSTEMS	1	/73	
	CAMAC-TO-SCIPP PHA INTERFACE	2323	BI RA SYSTEMS	2	/73	
	INTERFACE CAMAC-TO-LABEN 8000SERIES MULTICHANNEL ANALYZERS	5380	LABEN	3		
	MULTICHANNEL ANALYZER - CAMAC INTERFACE (FOR PACKARD 9000 AND 900 SERIES MCA)	9701	PACKARD	3		(4)
	SYNCHRO TO DIGITAL CONVERTER (SINGLE AND MULTI-TURN CAPABILITIES)	SDC	JOERGER	2	/73	
	DUAL SYNCHRO-DIGITAL CONVERTER (14BIT)	CS 0047	NUCL. ENTERPRISES	2	/73	
	DUAL INCREMENTAL POSITION ENCODER (2X20 BIT X-Y DIGITIZATION BY UP-DOWN COUNTER)	2IPE 2019	SEN	1	/71	
	INTERFACE FOR MEASURING DEVICES (DUAL INPUT FOR 2 INSTRUMENTS)	DO 200-1412	DORNIER	1	02/74	(10)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	OUTPUT REGISTER (16 OR 24 BIT TTL DRIVER FOR FAST-ROUTING MULTIPLEXER SYSTEM)	CM 665	J AND P	1	/71	
	PULSE DURATION DEMODULATOR	3720	KINETIC SYSTEMS	1	/73	
	WIRE DETECTOR SCANNER(64X16BIT MEMORY STORES 13BIT POSITION+3BIT CLUSTER DATA)	WCS-200	NANC SYSTEMS	1	/72	(5)
	SCANNER TEST MODULE	WCS-201		1	/72	(5)
	PLUMBICON READ OUT TERMINAL	J PG 10/PUDDING	SCHLUMBERGER	1	/71	(6)
	PLUMBICON READ OUT (5 SCALERS RECORD DIGITIZED OUTPUTS FROM PLUMBICON CAMERA)	J PM 10/PLUM	SCHLUMBERGER	1	/71	(6)
	SPARK CHAMBER READ OUT	J SC 10		2	/72	
	CONTROLLER-INTERFACE FOR DIGITAL PROCESSING SCOPE AND TRANSIENT DIGITIZER	APD/R7912	TEKTRONIX	2	/74	
	ADC/CAMAC INTERFACE (FOR ANY ADC,2X16BIT O/P BUFFER,STATUS,LAM HANDL,CLOCK TIME)	C-A1-2	WENZEL ELEKTRONIK	1	/73	(10)

147 Other Digital I/O Modules (Incl. Data Links)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	CAMAC DATA LINK MODULE (16 BIT PARALLEL,ASYNCHRONOUS DATA LINK)	6701	BI RA SYSTEMS	2	/73	
	BIT-SYNCHRONIZER - HARDWARE PROGRAMABLE 0 TO 10V INPUT, PCM-SIGNAL IN SERIES	DO 200-2251	DORNIER	3	/73	
	FORMAT-SYNCHRONIZER, IDENTIF & O/P OF DIGITAL DATA WORDS, HARDWARE PROGRAMABLE	DO 200-2261	DORNIER	4	/73	
	COMMUNICATION INTERFACE (V24/V23/V21 MODEM INTERFACE WITH AUTO-DIAL OPTION)	DO 200-2911	DORNIER	1	/73	(10)
	CONTROLLED TIMER (BUSY-DONE LOGIC)	CT021	EG&G/ORTEC	1	/73	
	START-STOP CONTROLLER(START,STOP,RESET, MANUAL OR DATAWAY CONTROL, 100HZ CLOCK)	FHC 1304	FRIESEKE	1	/71	(1)
	SERIAL INTERFACE (V24 SPEC)	9045	NUCL. ENTERPRISES	1	/73	
N	SERIAL INPUT/OUTPUT REGISTER 16BIT CODED	9063	NUCL. ENTERPRISES	1	11/74	
	START-STOP UNIT (START, STOP CLOCK AND GATE OUTPUTS)	J AM 10	SCHLUMBERGER	1	/71	
	FOUR FOLD BUSY DONE (START SIGNAL INITIATED BY COMMAND,DEVICE RETURNS LAM)	4BD 2021	SEN	1	/71	

15 Digital Handling and Processing Modules — and/or/nor Gates, Fan-Outs, Digital Level and Code Converters, Buffers, Delays, Arithm. Processors etc.

151 Fan-Outs, and/or/not-Gates

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	FAN-OUT UNIT (2 ORED INPUTS PROVIDE 8 TRUE,2 COMPLEM OUTPUTS,NIM SIGNALS)	FO 0801	GEC-ELLIOTT	1	/71	
	NIM FANOUT (DUAL FOUR FOLD & COMPLEMENT, NIM DRIVER, -14MA INTO 50OHMS)	FON	JOERGER	1	/73	
	TTL FANOUT (DUAL FOUR FOLD & COMPLEMENT, TTL DRIVER, 50MA CURRENT SINK)	FOT	JOERGER	1	/73	
	FAN OUT MODULE (IL2 I/P, 16 IL2 O/P)	9050	NUCL. ENTERPRISES	1	/73	
	SIX-FOLD CONTROLLED GATE (INDIV GATING, FAN-IN AND FAN-OUT CONTROLLED BY 3 REGS)	6CG 2017	SEN	1	/71	(4)

152 Digital Level Converters

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	6 CHANNEL TTL/NIM CONVERTER	5601	BI RA SYSTEMS	1	/73	
	6 CHANNEL NIM/TTL CONVERTER	5602	BI RA SYSTEMS	1	/73	
	HEX CONVERTER (NIM TO TTL LEVELS PLUS TWO COMPLEMENT OUTPUTS)	CNT	JOERGER	1	/73	
	HEX CONVERTER (TTL TO NIM LEVELS PLUS TWO COMPLEMENT OUTPUTS)	CTN	JOERGER	1	/73	
	HEX IL2 TO IL1 CONVERTER (6 NIM SIGNALS IN,6 TTL SIGNALS OUT)	7051-1	NUCL. ENTERPRISES	1	/70	
	HEX IL1 TO IL2 CONVERTER (6 TTL SIGNALS IN,6 NIM SIGNALS OUT)	7052-1	NUCL. ENTERPRISES	1	/70	
	QUIN L1 TO IL1 CONVERTER(5 HARWELL STANDARD L1 SIGNALS IN 5 TTL SIGNALS OUT)	7053-1	NUCL. ENTERPRISES	1	/70	

153 Code Converters

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	DECIMAL INPUT 6 NUMBERS 3 DIGIT CODE CONVERTER	DO 200-2005	DORNIFR	32	03/74	
	(SAME BUT 3 NUMBERS)	DO 200-2006	DORNIFR	2	03/74	
	CAMAC BCD-TO-BINARY CONVERTER	LEM-52/5.7	EISFNMANN	1		
	CAMAC BINARY-TO-BCD CONVERTER WITH DECIMAL DISPLAY	LEM-52/5.8	EISENMANN	1		
N	GRAY CODE TO BCD CONVERTER (DUAL CHANNEL INPUT WITH MEMORY)	EIR	JOERGER	1	10/74	
	BINARY CODE CONVERTER(BIN-BCD OR BCD-BIN CONVERSION, DATA FROM DATAWAY OR FRONT)	9044	NUCL. ENTERPRISES	1		(7)
	BINARY TO DECIMAL CODE CONVERTER (24 BIT BINARY TO 8 DECADE)	610	POLON	1	04/74	
	BINARY TO BCD-CONVERTER(24BIT TO 8 DECADE,DISPLAY,CONV 4USEC,TTL LEVEL OUT,1=H)	C-BBC-24	WENZEL ELEKTRONIK	2	/71	

154 Buffer Memories, Storage Units

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	PROGRAM STORE/REGISTER (256X24BIT RAM + 64X24BIT ROM, EXT ADDR, USE WITH 7025-2)	110A	HYTEC	1		
	(SAME BUT WITHOUT EDIT ROM)	110		1		
	(SAME BUT NO BUFFER AND NO EXT ADDR)	112		1	/73	
	3-DECADE ADC & 16-WAY MUX (PRESET X1-X10 AMPL, 16X24 STORE, 100USEC/CH UPDATE)	500-1	HYTEC	1	/73	
	(SAME BUT BINARY ADC)	501		1	/74	
	2048-WORD 16 BIT STORE	9061		2		(10)
	16 WORD STORE	CS 0003	NUCL. ENTERPRISES	1		(4)
	256 WORDS OF 24 BIT STORE MODULE	CS 0015	NUCL. ENTERPRISES	1	/72	(7)
N	PROGRAMMABLE READ ONLY MEMORY (32 WORDS, 18 BITS, LOADED BY SOLDER CONNECTIONS)	221	POLON	1		
	BUFFER MEMORY (256 16BIT WORDS, USE WITH J CAN 21/C/H)	J MT 20	SCHLUMBERGER	1	/72	

155 Logic and Arithmetic Processing Modules

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	FLOATING POINT ARITHMETIC INTERFACE (FOR USE WITH M 128 HARD. FLOAT. POINT)	C 327	INFORMATEK	1	/73	

16 Analogue Modules — ADC, DAC, Multiplexers, Amplifiers, Linear Gates, Discriminators etc.

161 Analogue Input Modules (DC and Pulse ADC, TDC)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
C	32 CHANNEL ANALOG DATA SYSTEM (EXPANDABLE WITH ADDITIONAL MUX MODULES)	5301	BI RA SYSTEMS	2	01/74	
	ANALOG INPUT (DUAL SLOPE ADC, +/-10V RANGE,14BITS/10V+SIGN,0.2SEC CONVERSION)	DO 200-1021	DORNIER	1	/72	
	DUAL DIGITAL VOLTMETER (2X10BIT, DIFF INPUT, +100MV TO -100MV)	DV013	EG&G/ORTEC	1	/73	
	ANALOGUE TO DIGITAL INTEFACE (WITH PLUG-IN CONVERTER CARDS ADC/8Q, ADC/10Q AND ADC/12Q FOR 8, 10 AND 12 BIT CONVERSION)	ADC 1201	GEC-ELLIOTT	1	/71	(1)
	INTEGRATING ADC (12BIT, RANGES 0 TO +5V, 0 TO -5V, 40MSEC CONVERSION TIME)	700	POLON	1	/73	
	VOLTAGE - FREQUENCY CONVERTER (USED WITH MULTIPLEXERS J MX 10/20)	J CTF 10	SCHLUMBERGER	2	/73	
	UP-DOWN SCALER/FREQUENCY METER	J EF 10		1	/73	
	DUAL DIGITAL VOLTMETER (+AND- 0.1V, 10 BIT, DIFFERENTIAL INPUT)	2DVM 2013	SEN	1	/71	
	DIG. VOLTMETER (12BIT + SIGN, POT-FREE RANGES--AC/DC .02V - 20V,DC 5-100MA)	C 76451-A13-A1	SIEMENS	2	/73	
	DIGITAL VOLTMETER (SAME AS TYPE C 76451-A13-A1 WITH DISPLAY)	C 76451-A13-A2	SIEMENS	2	/73	
	ANALOG INPUTS (MULTIPLEXER-ADC, 8 DIFF I/P,+/-10V RANGE,7BITS/10V+SIGN)	DO 200-1013	DORNIER	2	/72	
	ANALOG INPUTS (MULTIPLEXER-ADC, TO ONE ADC,+/-5V RANGE,7BITS/ 5V+SIGN)	DO 200-1016	DORNIER	2	/72	
	ANALOG INPUTS (MULTIPLEXER-ADC, 8 DIFF I/P, +10V RANGE,8BITS/10V)	DO 200-1019	DORNIER	2	/72	

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	ANALOG INPUT (ADC, +/-10V RANGE, 7BITS/10V+SIGN)	DO 200-1027	DORNIER	2	/72	
	(SAME FOR +/-5V RANGE, 7BITS/5V +SIGN)	DO 200-1028		2	/72	
	(SAME FOR +10V RANGE, 8BITS/10V)	DO 200-1029		2	/72	
	ANALOGUE TO DIGITAL CONVERTER(8BIT, I/P RANGE 0 TO +5V OR 0 TO -5V,25 USEC CONV)	7028-1	NUCL. ENTERPRISES	1	/70	
	SUCCESS. APPROX. ADC (WITH S+H, +/-5V OR 0 TO +/-10V, 12-BIT,23/13 USEC ACCESS)	1244/1244A	BORER	2	/73	(9)
	DUAL 10 BIT ANALOG TO DIGITAL CONVERTER	3515	KINETIC SYSTEMS	1	/73	
	DUAL SLOPE ADC (+AND- 0.01/1/10V RANGES, 11BIT RESOLUTION,20MS CONV TIME)	1241	BORER	2	/72	(3)
	SUCCESS. APPROX. ADC (WITH S+H, +/-5V OR 0 TO +/-10V, 10-BIT,20/11 USEC ACCESS)	1243/1243A	BORER	2	/72	(9)
	ANALOG INPUTS (MULTIPLEXER-ADC, 8 DIFF I/P,+/-10V RANGE,11BITS/10V+SIGN)	DO 200-1003	DORNIER	2	/72	
	ANALOG INPUTS (MULTIPLEXER-ADC, 8 DIFF I/P,+/-5V RANGE,11BITS/ 5V+SIGN)	DO 200-1006	DORNIER	2	/72	
	ANALOG INPUTS (MULTIPLEXER-ADC, 8 DIFF I/P, +10V RANGE, 12BITS/10V)	DO 200-1009	DORNIER	2	/72	
	ANALOG INPUT (ADC, +/-10V RANGE, 11BITS/10V+SIGN)	DO 200-1024	DORNIER	2	/72	
	(SAME FOR +/-5V RANGE,11BITS/ 5V+SIGN)	DO 200-1025		2	/72	
	(SAME FOR +10V RANGE,12BITS/10V)	DO 200-1026		2	/72	
	3-DECADE ADC & 16-WAY MUX (PRESET X1-X10 AMPL, 16X24 STORE, 100USEC/CH UPDATE)	500-1	HYTEC	1	/73	
	(SAME BUT BINARY ADC)	501		1	/74	
	(SAME, BUT AMPL GAIN CAN BE SET AND STORED INDIVIDUALLY/CHANNEL, BCD/BIN)	510		2	06/74	
	16-CHANNEL A/D CONVERTER (DIFFERENTIAL INPUTS, 11 BITS + SIGN)	AM-1	JOERGER	2	06/74	(11)
	A/D CONVERTER (12BIT,MAX 20 USEC CONVERSION, +AND-5V, +AND-10V, +10V RANGES)	30	JORWAY	2	/71	(2)
	DUAL 12 BIT ANALOG TO DIGITAL CONVERTER	3520	KINETIC SYSTEMS	1	/73	
	ANALOGUE TO DIGITAL CONVERTER (12BIT, 20 MSEC CONVERSION,RANGE -5V TO +5V)	7055-1	NUCL. ENTERPRISES	1	/70	
	OCTAL CHARGE DIGITIZER (8X8BIT CHARGE SENSITIVE ADC, READOUT IN 4X16BIT WORDS)	QD808	EG&G/ORTEC	1		(7)
	QUAD FAST GATED INTEGRATOR (CHARGE DIGITIZER, 4X10 BIT)	QD410	EG&G/ORTEC	1	02/74	(10)
	MULTI-MODE LINEAR ADC (8BIT,40MHZ CLOCK, AREA AND PEAK MODES,NIM LEVELS)	2243A	LRS-LECROY	1	/70	(2)
	OCTAL ADC (8 FAST I/P,8BIT/CH, COMMON GATE, NIM LEVELS, BILINEAR MODE)	2248	LRS-LECROY	1	/71	
	12-CHANNEL ADC (12 FAST I/P, 10BIT/CH, .25PC SENSITIVITY, FAST CLEAR)	2249A	LRS-LECROY	1	01/74	(9)
	OCTAL ADC (MIN 5 NSEC PULSES, POS OR NEG 8BIT/100 PC RESOLUTION, 250 USEC CONV)	9040	NUCL. ENTERPRISES	1	/72	(4)
	ANALOGUE TO DIGITAL CONVERTER (80MHZ, 12 BITS)	9060	NUCL. ENTERPRISES	1	06/74	(10)
	16.000 CHANNEL PULSE ADC (200MHZ CLOCK)	J CAN 21 C/H	SCHLUMBERGER	6	/72	(6)
	1024 CHANNEL PULSE ADC (100MHZ CLOCK)	J CAN 40	SCHLUMBERGER	2	/72	(6)
N	16 CHANNEL A/D CONVERTER (FET MUX DIFF INPUTS, 12BIT AUTO CYCLING, DUAL SLOPE)	34	JORWAY	2	/74	
N	EVENT TIMER(4-CHANNEL TIME DIGITIZER, 8B 100MHZ INT. CLOCK, LAM WHEN DONE)	2205	BI RA SYSTEMS	1	/74	
	QUAD CAMAC SCALER (4X16BIT OR 2X32BIT, 40MHZ)	1004	BORER	1	/72	
	TIME DIGITIZER (4X16BIT,50MHZ CLOCK,WITH CENTRE FINDER, USABLE WITH PRE-AMP 511)	1005	BORER	1	/72	
	TIME DIGITIZER (4 NIM STOP CHANNELS, COMMON START, 200 PSECS RESOLUTION)	TD104	EG&G/ORTEC	1		(7)
	QUAD TIME DIGITIZER (SPARK CHAMBER READOUT, CENTER FINDING LOGIC)	TD031	EG&G/ORTEC	1	/73	
	TIME DIGITIZER (6 CHANNELS,16 BITS, 100 MHZ CLOCK RATE)	TD	JOERGER	1	08/74	(11)
	QUAD TIME-TO-DIGITAL CONVERTER(9BIT/CH, 102/510NSEC RANGES,13USEC CONVERS,NIM)	2226A	LRS-LECROY	1	/70	(2)
	OCTAL TIME-TO-DIGITAL CONVERTER(10BIT/CH 102/204NSEC RANGES, FAST CLEAR)	2228	LRS-LECROY	1	01/74	(9)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	SIXTEEN FOLD TIME-TO-DIGITAL-CONVERTER (100MHZ EXT CLOCK, 48IT SCALERS USED)	TDC-16	NUCLETRON	1	06/74	
	TIME DIGITIZER(4X16BIT,CLOCK RATE 70/85MHZ, WITH CENTER FINDING LOGIC)	TD 2031	SEN	1	/72	
	TIME DIGITIZER (4X16BIT,CLOCK RATE 70/85MHZ,NIM LEVELS)	TD 2041	SEN	1	/72	(4)
	SERIAL TIME DIGITIZER (8X8BIT 100MHZ, SER + SEQUENT COUNT MODE,SHIFT-REG GATE)	STD 2050	SEN	1	/72	

162 Analogue Output Modules (DAC)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	8 CHANNEL 8 BIT D/A CONVERTER (CURRENT OR VOLTAGE O/P,SLOW ANALOG METER DRIVER)	5405	BI RA SYSTEMS	1	/73	
	ANALOG OUTPUT (DAC 8BIT RESOLUTION, +10V OUTPUT RANGE, 5MA)	DO 200-1511	DORNIER	1	/73	
	(SAME BUT 12BIT RESOLUTION)	DO 200-1521		1	/73	
	ANALOG OUTPUT (DAC 8BIT RESOLUTION, +10V OUTPUT RANGE, 5MA, 2 OUTPUTS)	DO 200-1512	DORNIER	1	/73	
	(SAME BUT 12BIT RESOLUTION)	DO 200-1522		1	/73	
	ANALOG OUTPUT (DAC 8BIT RESOLUTION, +AND-10V OUTPUT RANGE, 5MA)	DO 200-1513	DORNIER	1	/73	
	(SAME BUT 12BIT RESOLUTION)	DO 200-1523		1	/73	
	ANALOG OUTPUT (DAC 8BIT RESOLUTION, +AND-10V OUTPUT RANGE, 5MA, 2 OUTPUTS)	DO 200-1514	DORNIER	1	/73	
	(SAME BUT 12BIT RESOLUTION)	DO 200-1524		1	/73	
	ANALOG OUTPUT (DAC 8BIT RESOLUTION, +AND-5V OUTPUT RANGE, 5MA)	DO 200-1515	DORNIER	1	/73	
	(SAME BUT 12BIT RESOLUTION)	DO 200-1525		1	/73	
	ANALOG OUTPUT (DAC 8BIT RESOLUTION, +AND-5V OUTPUT RANGE, 5MA, 2 OUTPUTS)	DO 200-1516	DORNIER	1	/73	
	(SAME BUT 12BIT RESOLUTION)	DO 200-1526		1	/73	
	ANALOG OUTPUT (DAC 8BIT RESOLUTION, +10V OUTPUT RANGE, 5MA, 4 OUTPUTS)	DO 200-1517	DORNIER	1	/73	
	(SAME BUT 12BIT RESOLUTION)	DO 200-1527		1	/73	
	ANALOG OUTPUT (DAC 8BIT RESOLUTION, +AND-10V OUTPUT RANGE, 5MA, 4 OUTPUTS)	DO 200-1518	DORNIER	1	/73	
	(SAME BUT 12BIT RESOLUTION)	DO 200-1528		1	/73	
	ANALOG OUTPUT (DAC 8BIT RESOLUTION, +AND-5V OUTPUT RANGE, 5MA, 4 OUTPUTS)	DO 200-1519	DORNIER	1	/73	
	(SAME BUT 12BIT RESOLUTION)	DO 200-1529		1	/73	
	OCTAL DAC (10BIT,0-5V,500HMS.10USECS)	DAC 1082	GEC-ELLIOTT	1	/73	
	(SAME BUT WITH 2'S COMPLEMENT 9BIT+SIGN, +AND- 5V, 500HMS)	DAC 1082(B)		1	/73	
	QUAD DAC (4 CHANNEL VERSION OF DAC 1082)	DAC 1042	GEC-ELLIOTT	1	/74	
	(SAME, 4 CHANNEL VERSION OF DAC 1082(B)	DAC 1042(B)		1	/74	
	DUAL D/A CONVERTER (10 BIT, 10USEC CONV TIME, +10V, +AND-10V, +AND-5V RANGES)	D/A-10	JOERGER	1	/73	
	DUAL D/A CONVERTER (12 BIT, 30USEC CONV TIME, +10V, +AND-10V, +AND-5V RANGES)	D/A-12	JOERGER	1	/73	
	OCTAL D/A CONVERTER (8BIT RESOLUTION, 0 TO 2MA OR 0 TO +10V OUT)	8 D/A	JOERGER	1	/73	
	D/A CONVERTER (12BIT,5 USEC CONVERSION, O/P RANGES +AND-2.5V/5V/10V AND +5V/10V)	31	JORWAY	1	/71	(2)
	8 CHANNEL 10 BIT D-A CONVERTER	3110	KINETIC SYSTEMS	1	/72	
	DIGITAL TO ANALOGUE CONVERTER	7015	NUCL. ENTERPRISES	1	/70	
	DUAL DIGITAL-TO-ANALOG CONVERTER (10BIT, OUTPUT 0 TO +10V OR -5 TO +5V)	2DAC 2011	SEN	1	/71	
	DUAL DAC (10BIT, +AND-10V OR +AND-20MA)	C 76451-A15-A2	SIEMENS	1	/73	
	DUAL DAC (12BIT, +AND-10V)	C 76451-A15-A3		1	/73	(6)
N	ISOLATED DUAL DAC (10BIT,30USEC,10V/5MA, OPTOCOUPLER,4 TIMING MODES,RANGE-MODIF)	C/DA-210	WENZEL ELEKTRONIK	1	/74	
N	QUAD DAC (8BIT,10USEC,5V/50MA,4TIMING-M, +,- &RANGE MODIF,OPT.GROUND-REJ&.5USEC)	C-DA-408	WENZEL ELEKTRONIK	1	/74	(11)
N	QUAD DAC(10BIT,10USEC,5V/50MA,4TIMING-M, +,- &RANGE MODIF,OPT.GROUND-REJ&.5USEC)	C-DA-410	WENZEL ELEKTRONIK	1	/74	(11)

164 Analogue Handling and Processing Modules I (MX)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	SEE ALSO DORNIER ADC TYPES		DORNIER			
	(SAME, BUT AMPL GAIN CAN BE SET AND STORED INDIVIDUALLY/CHANNEL, BCD/BIN)	510	HYTEC	2	06/74	
	12 INPUT ANALOGUE MULTIPLEXER (RANDOM OR SCAN ACCESS CONTROLLED BY SKIP REGISTER)	MX 2025	SEN	1	/72	(6)
	15 CHANNEL MULTIPLEXER (ANALOGUE SIGNALS ROUTED TO ADC/DVM,DIRECT + SCAN MODES)	1701	BORER	1	/72	(3)
	RELAY MULTIPLEXER (16 CHANNELS,MAX 200V/750MA OR 10VA, DATAWAY SET+INCR ADDRESS)	DO 200-1035	DORNIER	2	/71	
	(WITH FRONT PANEL CONNECTOR)	DO 200-1235		2	/71	
	RELAY MULTIPLEXER(16 CHANNELS, MAX 200V/750MA OR 10VA, DATAWAY SET+INCR ADDRESS)	DO 200-1036	DORNIER	1	/72	
	(WITH FRONT PANEL CONNECTOR)	DO 200-1236		1	/72	
	ANALOG MULTIPLEXER (15 CHANNELS,REED RELAYS,MAN AND DATAWAY SEL, EXPANDABLE)	AM	JOERGER	2	/72	(6)
	16-CHANNEL A/D CONVERTER (DIFFERENTIAL INPUTS, 11 BITS + SIGN)	AM-1	JOERGER	2	06/74	(11)
	15 CHANNEL RELAY MULTIPLEX	3530	KINETIC SYSTEMS	2	/73	
	MASTER MULTIPLEXER (16 CH, 4 POLE REED)	601	NUCL. ENTERPRISES		/70	
	SLAVE MULTIPLEXER (16 CH, 4 POLE REED)	600			/70	
	16 CHANNEL RELAY MULTIPLEXER STANDARD LEVEL)	J MX 10	SCHLUMBERGER	1	/73	
	(SAME FOR LOW LEVEL)	J MY 20		1	/73	
	MULTIPLEXER MANUAL CONTROL	J AX 10		1	/73	
	16-CHANNEL FAST MULTIPLEXER (FET SWITCHES FOR ADC 1243 AND 1244)	1704	BORER	1	/72	(4)
	FET MULTIPLEXER (16 DIFF I/P, MAX +OR-10V, DATAWAY SET+INCR ADDRESS)	DO 200-1034	DORNIER	1	/72	
	(WITH FRONT PANEL CONNECTOR)	DO 200-1234		1	/72	
N	16 CHANNEL A/D CONVERTER (FET MUX DIFF INPUTS, 12BIT AUTO CYCLING, DUAL SLOPE)	34	JORWAY	2	/74	
	MULTIPLEXER-SOLID STATE (16 SINGLE-ENDED OR 8 DIFF CHAN,RANDOM OR SEQUENT ACCESS)	9026	NUCL. ENTERPRISES	1	/71	
	32 CHANNEL ANALOG MULTIPLEXER (SERVE AS CHANNEL EXPANDER FOR 5301 DATA SYSTEM)	5101	BI RA SYSTEMS	1	02/74	
	MULTIPLEXER (32 CHANNEL, 2 CONTACTS)	C 76451-A4-A1	SIEMENS	2	/73	
	MULTIPLEXER (32 CHANNEL, 4 CONTACTS)	C 76451-A4-A2	SIEMENS	2	/73	
	FET MULTIPLEXER (32 CHANNELS, MAX +OR-10V, DATAWAY SET+INCR ADDRESS)	DO 200-1032	DORNIER	1	/72	
	(WITH FRONT PANEL CONNECTOR)	DO 200-1232		1	/72	
	FET MULTIPLEXER (32 DIFF I/P, MAX +OR-10V, DATAWAY SET+INCR ADDRESS)	DO 200-1037	DORNIER	2	/72	
	(SAME WITH FRONT PANEL CONNECTORS)	DO 200-1237		2	/72	
	FET MULTIPLEXER (64 CHANNELS MAX +OR-10V, DATAWAY SET+INCR ADDRESS)	DO 200-1061	DORNIER	2	/73	
	(WITH FRONT PANEL CONNECTOR)	DO 200-1261		2	/73	

165 Analogue Handling and Processing Modules II (Lin. Gates, Ampl., Discriminators etc.)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	LINEAR GATE	1105	POLON	1	/73	
N	PULSE STRETCHER	1106	POLON	1		
N	SINGLE CHANNEL ANALYSER (RESOLUTION 1US)	1201	POLON	3	03/74	
N	LOGIC SHAPER AND DELAY	1401	POLON	2	03/74	
N	UNIVERSAL COINCIDENCE	1402	POLON	2	04/74	
N	FAN OUT	1504	POLON	1	/73	
	SAMPLE-AND-HOLD AMPLIFIER (DUAL DIFF AMPL,+/-10V RANGE,20MA OUT,5USEC SETTL)	DO 200-1040	DORNIER	2	/72	
	(SINGLE AMPL VERSION, BOTH TYPES HAVE HOLD AND TRACK MODES)	DO 200-1041		2	/72	
	PROGRAMABLE AMPLIFIER/ATTENUATOR (ATTENUATION -60DB TO 0DB, 6 STEPS, AMPLIFICATION 0DB TO 60DB, 6 STEPS)	DO 200-1052	DORNIER	2	/73	
	PROGRAMABLE AMPLIFIER/ATTENUATOR (ATTENUATION -60DB TO 0DB IN 6 STEPS, GAIN 0DB TO 60DB IN 6 STEPS, 2 CHANNELS)	DO 200-1053	DORNIER	1 NA	/73	
	DIFFERENTIAL AMPLIFIER (GAIN CONTROLLED FROM DATAWAY)	CS 0014	NUCL. ENTERPRISES	2	/72	

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	DIGITAL WINDOW DISCRIMINATOR (WITH 128X16BIT BUFFER, PARALLEL + SERIAL I/P)	DWD 2046	SEN	1	/72	(8)

17 Other Digital and/or Analogue Modules — Mixed Analogue and Digital, Not Dataway Connected etc.

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	NUMERICAL CONTROL SYSTEM COMPRISING CASSETTE RECORER C 503, DATA WRITER AND DISPLAY C 504, AND TYPES	C 500	RDT	NA		
	SERIAL CONTROLLER	C 502		0		
	DATA RECEIVER FOR MECHANICAL OPERATIONS (5 DECADE DATA,3 DECADE INSTRUCTION REG)	C 501		0		(7)
	CURRENT SOURCE (1MA TO 10MA AND FOR PT 100 ADAFTOR)	C 76451-A5-A1	SIEMENS	2	/73	

2 SYSTEM CONTROL EQUIPMENT — COMPUTER COUPLERS, CONTROLLERS AND RELATED EQUIPMENT

21 Interfaces/Drivers and Controllers — Parallel Mode for 4600 Branch and Other Multi-Crate Bus, Single-Crate Systems, Autonomous Systems

211 Interfaces/Drivers for Multicrate Systems I (4600 Branch Compatible)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	EXECUTIVE SUITE ASSEMBLY OF MODULAR CONTROLLERS IN CAMAC CRATE, COVERS SYSTEM COMPLEXITY FROM SINGLE SOURCE-SINGLE CRATE TO MULTI SOURCE-MULTI CRATE SYSTEMS,COMPRISING		GEC-ELLIOTT			
	EXECUTIVE CONTROLLER (TRANSFORMS STANDARD CRATE INTO SYSTEM CRATE)	MX-CTR-2		2	/72	
	BRANCH COUPLER (ONE PER BRANCH, MAX 7)	BR-CPR-2		2	/72	
	AND SYSTEM INTERFACE SOURCE UNITS, ALSO OPTIONALLY AUTONOMOUS CONTROLLER SOURCE UNITS (ALL INSERTED INTO SYSTEM CRATE)		GEC-ELLIOTT			
	AUTONOMOUS CONTROLLER 1 (FOR MULTILEVEL AUTONOMOUS BLOCK TRANSFERS VIA DMA)	SC-ACU-1	GEC-ELLIOTT	1	/73	
	PDP-11 SYSTEM INTERFACE, COMPRISING		GEC-ELLIOTT			
	PROGRAM TRANSFER INTERFACE	PTI-11 C/D		3	/72	
	UNIBUS TERMINATION UNIT	TRM-11		1	/72	
	SYSTEM INTERFACE BUS (LINKS UNIBUS TO ALL SI SOURCE UNITS FORMING INTERFACE)	SI-BUS-X11			/72	
	INTERRUPT VECTOR GENERATOR (ADDS AUTONOMOUS ENTRY OF GL-DERIVED INTERRUPTS)	IVG-11		1	/72	
	DIRECT MEMORY ACCESS INTERFACE (ADDS MULTICHANNEL DMA,NEEDS AUTONOMOUS CTRL)	DMA-11		1	/73	
	NOVA/SUPERNOVA SYSTEM INTERFACE, COMPR		GEC-ELLIOTT			
	PROGRAM TRANSFER INTERFACE	PTI-N C/D		3	/72	
	I/O BUS TERMINATION UNIT	TRM-N		1	/72	
	SYSTEM INTERFACE BUS	SI-BUS-XN			/72	
	INTERRUPT VECTOR GENERATOR	IVG-N		1	/73	
	INTERDATA 70-SERIES SYSTEM INTERFACE COMPRISING		GEC-ELLIOTT			
	PROGRAM TRANSFER INTERFACE	PTI-70 C/D		3	/73	
	I/O BUS TERMINATION UNIT	TRM-70		1		
	SYSTEM INTERFACE BUS	SI-BUS-X70			/73	
	INTERRUPT VECTOR GENERATOR	IVG-70		1	/73	
	HONEYWELL 316/516 SYSTEM INTERFACE,COMPR		GEC-ELLIOTT			
	PROGRAM TRANSFER INTERFACE	PTI-H16 C/D		3	/73	
	I/O BUS TERMINATION UNIT	TRM-H16		1		
	SYSTEM INTERFACE BUS	SI-BUS-XH16			/73	
	GEC 2050/4080 SYSTEM INTERFACE, COMPR		GEC-ELLIOTT			
	DIRECT TRANSFERS INTERFACE	PTI-2050 C/D		3	/73	
	SYSTEM INTERFACE BUS	SI-BUS-X2050			/73	
	SYSTEM CRATE TEST UNIT (TWO-COMMAND TEST UNIT FOR CHECKING SYSTEM CRATE SYSTEMS)	SC-TST-1	GEC-ELLIOTT	3	/72	
	BIDIRECTIONAL DATA BREAK MODULE FOR PDP8 COMPUTERS (FOR USE WITH 7048-2)	1000	HYTEC	2	09/74	
	MICROPROGRAMMED BRANCH DRIVER FOR PDP-11 (WITH 256, 512, OR 1K WORDS OF MEMORY)	1201	BI RA SYSTEMS	NA	/72	(5)
	UNIBUS CABLE ASSEMBLY	3101			/72	
	PDP-11 CAMAC CONTROLLER(SEQUENTIAL READ/WRITE,24 GRADED-L INTERRUPT DIRECTLY)	CA 11-A	D E C	NA	/71	(2)
	PDP-15 CAMAC INTERFACE(18/24BIT,PROGR, SEQUENT ADDR AND BLOCK TRANSFER MODES)	CA 15 A	D E C	NA	/71	(1)
	PDP-9 CAMAC INTERFACE (SOMEWHAT MODIFIED CA 15 A)	CA 15 A/PDP-9	D E C	NA	/71	
	PDP-11 INTERFACE/BRANCH DRIVER (24 VECTOR ADDRESSES, PROGRAMMED AND MULTIPLE DMA-TRANSFER, ADDRESS SCAN AND -LIST MODE, REPEAT-, LAM- AND STOP MODE)	CA 11-C	D E C	NA	/72	(4)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	PDP-11 BRANCH DRIVER (EUR 4600 COMPATI-BLE,PROGRAMMED AND SEQUENT ADDR MODES)	BD-011	EG&G/ORTEC	NA	/71	
	PDP-11 BRANCH DRIVER	KS 0011	KINETIC SYSTEMS	NA	/71	(4)
	INTERFACE AND DRIVER FOR PDP 11 OR PDP 8 MULTI-CRATE SYSTEM, COMPRISING		NUCL. ENTERPRISES			
	BRANCH INTERFACE	9031		2	/72	(7)
	16-BIT CONTROLLER (WITH EITHER OF THE FOLLOWING INTERFACE CARDS)	9030		3	/72	(7)
	PDP 11 INTERFACE CARD	9032			/72	
	INTERFACE CARD FOR DEC PDP 8 SERIES	9034			/73	(7)
	INTERFACE CAMAC-PDP 11 (PROGRAMMED,BLOCK TRANSFER AND SEQUENTIAL ADDR MODES)	ICP 11/ICP 11 A	SCHLUMBERGER	NA	/71	(4)
C	NOVA BRANCH DRIVER	1251-1	BI RA SYSTEMS	NA	/73	(5)
N	NOVA BRANCH DRIVER WITH DATA CHANNEL	1251-2	BI RA SYSTEMS	NA	/74	(5)
	INTERFACE/SYSTEM CONTROLLER TO HP2100, 2114, 2115, 2116	2201	BORER	NA	/71	(4)
	INTERFACE FOR VARIAN 620I/L/F COMPUTER (PROGR,SEQUENT AND BLOCK TRANSFERS)	2204	BORER	NA	/72	
	SYSTEM CONTROLLER FOR SIEMENS 404/3 (TRANSFER OF 16 OR 24 BIT DATAWORDS PARALLEL BRANCH COMMAND CHAINING)	DO 200-2921	DORNIER	6	/73	
	(SAME BUT WITHOUT COMMAND CHAINING)	DO 200-2922		6	/73	
	SYSTEM CONTROLLER FOR SIEMENS 404/3 (TRANSFER OF 16 OR 24 BIT DATAWORDS PARALLEL BRANCH BUT NO COMMAND CHAINING)	DO 200-2923	DORNIER	6	/73	
	BRANCH DRIVER-INTERFACE FOR SPC-16-SER WITH PROGRAMMED & DMA DATA TRANSFER MODE	CBD 16/MOD 72-077	GENERAL AUTOMATION	0	AN/74	
	MICRODATA 800/CIP 2000 BRANCH DRIVER	91	JORWAY	NA	/73	(7)
	BRANCH DRIVER (24BIT, PROGR, SEQUENT AND BLOCK TRANSFER MODES, MAX 7 CRATES)	5400	LABEN	4		(8)
	INTERFACE-DRIVER FOR VARIAN 73/620I/620L MULTI-CRATE SYSTEM, COMPRISING		NUCL. ENTERPRISES			(8)
	BRANCH INTERFACE	9031		2	/72	(7)
	16-BIT CONTROLLER	9030		3	/72	(7)
	AND					
	INTERFACE CARD FOR VARIAN 73/620I/620L SERIES COMPUTERS	CS 0044				(8)
	INTERFACE FOR K202 COMPUTER (24BIT,AUTONOMOUS BLOCK TRANSFERS TO/FROM MEMORY, L-NUMBER INTERRUPT ENCODER)	100	POLON	3	/73	
	SYSTEM CONTROLLER FOR SIEMENS 320/330 (AUTO-GL, 24 VECTOR ADDR, PROGRAMMED & DMA TRANSF, ADDR-SCAN,INCREM,RANDOM LIST REPEAT,LAM & STOP MODES)	C 72451 A1602	SIEMENS	8	/74	

212 Interfaces/Drivers for Multicrate Systems II (For other Parallel Mode Control/Data Highway)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	DEDICATED CRATE CONTROLLER FOR NOVA	NC023	EG&G/ORTEC	2	/73	
	TERMINATOR FOR NOVA I/O BUS	NT022		1	/73	
	DATAWAY CONTROLLER DDP-516(PART OF 7000-SER SYSTEM WITH EXT CONTROL HIGHWAY)	7022-1	NUCL. ENTERPRISES	4	/70	
	PROGRAMMED DATAWAY CONTROLLER (PART OF 7000-SER SYSTEM WITH EXT CONTR HIGHWAY)	7025-2	NUCL. ENTERPRISES	2	/70	
	COMMAND GENERATOR	7062-1		2	/71	
	TRANSFER REGISTER	7063-1		1	/70	
	PROGRAM CONTROL UNIT	0362-2		NA	/70	
	WIRED STORE	7044-1		1	/70	
	PLUGBOARD STORE	7077-1		3	/71	
	CRATE CONTROLLER FOR NOVA COMPUTER	CC 2023A/B	SEN	2	/70	
	CRATE CONTROLLER BUS TERMINATOR FOR CC 2023A/B (ONE PER SYSTEM)	BT 2022		1	/71	

213 Interfaces/Drivers for Single-Crate Systems (4100 Dataway Compatible)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	SINGLE CRATE SYSTEM CONTROLLERS(SEE EXECUTIVE SUITE, CLASS .211)		GEC-ELLIOTT			
	PDP-11-SERIES CRATE CONTROLLER	1304	BI RA SYSTEMS	2	/73	
	CRATE CONTROLLER/PDP11 UNIBUS INTERFACE	1533A	BORER	2	/72	(4)
	NPR CONTROLLER FOR DMA TO PDP11 E.G. VIA 1533A CRATE CONTROLLER/INTERFACE	1542		NA	/73	(8)
	SINGLE CRATE CONTROLLER/PDP-11 INTERFACE	CA-11-E	D E C	2	01/74	(9)
	DEDICATED CRATE CONTROLLER FOR PDP-11 (MULTIPLE TRANSFER OR AUTO ADDRESS SCAN)	DC011	EG&G/ORTEC	2		(7)
	UNIBUS CRATE CONTROLLER PDP-11	3911	KINETIC SYSTEMS	2	/72	
	INTERFACE AND DRIVER FOR PDP 11 OR PDP 8 SINGLE CRATE SYSTEM, COMPRISING		NUCL. ENTERPRISES			
	16-BIT CONTROLLER (WITH EITHER OF THE FOLLOWING INTERFACE CARDS)	9030		3	/72	(7)
	PDP 11 INTERFACE CARD	9032			/72	
	INTERFACE CARD FOR DEC PDP 8 SERIES	9034			/73	(7)
	AUTONOMOUS CONTROLLER FOR PDP 11	9033	NUCL. ENTERPRISES	2	/73	(8)
	CAMAC CRATE-PDP 11 INTERFACE	J CC 11	SCHLUMBERGER	2		(7)
N	UNIBUS TERMINATOR	J UT 11		1	/74	
N	UNIBUS EXTENDER	C BEX 11			/74	
	CRATE-SYSTEM CONTROLLER FOR PDP-11 (24 BIT READ & WRITE CAPABILITIES)	C-CSC-11	WENZEL ELEKTRONIK	2	/72	
	NOVA-SERIES CRATE CONTROLLER	1303	BI RA SYSTEMS	2	/73	
	SINGLE CRATE CONTROLLER TO HP COMPUTERS (CERN TYPE 066)	1531	BORER	2	/72	
	VARIAN-CAMAC INTERFACE CRATE CONTROLLER (16BIT SEQUENT+BLOCK TRANSF, 1 CC/CRATE)	C 300	INFORMATEK	2	/72	
	INTERFACE-DRIVER FOR VARIAN 73/620I/620L SINGLE CRATE SYSTEM,COMPRISING		NUCL. ENTERPRISES			(8)
	16-BIT CONTROLLER AND	9030		3	/72	(7)
	INTERFACE CARD FOR VARIAN 73/620I/620L SERIES COMPUTERS	CS 0044				(8)
	CRATE INTERFACE FOR MULTI 20 OR MULTI 8	J CM 8/20	SCHLUMBERGER	3	/74	
	CRATE CONTROLLER 320	C 72451-A1446-A6	SIEMENS	3	/72	
	CRATE CONTROLLER 404	C 76451-A1446-A7	SIEMENS	2	/73	

214 Controllers for Autonomously operated Systems (and Related Units)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	DATA PROCESSOR (AUTONOMOUS PROGRAMABLE SINGLE DATAWAY CONTROLLER 16 REGISTERS	DO 200-2951	DORNIER	3	/73	

217 Other Parallel Mode Interfaces/Drivers/Controllers

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	SYSTEM CRATE CONTROLLER	3960	KINETIC SYSTEMS	2	/73	
	MODCOMP I,MODCOMP II & MODCOMP III SYSTEM DRIVER(USE WITH 3960)	3970		2	/73	
	PDP-11 SYSTEM DRIVER (USE WITH 3960)	3971		2	04/74	
	MANUAL SYSTEM DRIVER(USE WITH 3960)	3980		2	/73	

22 Interfaces/Controllers/Drivers for Serial Highway

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	SERIAL EXTENSION UNIT. 8 BIT BYTE SERIAL LINK, BRANCH COMPATIBLE, CONSISTING OF		JOERGER		/73	(8)
	SERIAL DRIVER (TERMINATES BRANCH HIGHWAY AND RETRANSMITS COMMAND SERIALLY)	SD		2		
	SERIAL RECEIVER (RECEIVES SERIAL DATA, DRIVES TYPE A-1 SYSTEM, OPTICAL ISOL)	SR		2		
N	SERIAL CRATE CONTROLLER "L-1" (CONFORMS TO ESONE/SH/01 & TID-26488 + ERRATA)	74	JORWAY	2	/74	(11)
N	MANUAL SERIAL DRIVER (BIT/BYTE MODE, MULTIPLE MESSAGES, ERROR GENERATION)	78	JORWAY	4	12/74	
	TYPE L-1 CRATE CONTROLLER FOR THE "STANDARD" SERIAL HIGHWAY	3950	KINETIC SYSTEMS	2	03/74	(9)
	DRIVER FOR SERIAL HIGHWAY	3992	KINETIC SYSTEMS	3	01/74	(11)

23 Units Related to 4600 Branch or Other Parallel Mode Control/Data Highway — Crate Controllers, Terminations, Lam Graders, Branch/Bus Extenders

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	DISPLAY DRIVER(CONTROLS 72A DISPLAY, ALSO CRATE CTR AND BRANCH DRIVER)	72A	JORWAY	5	/71	

231 Crate Controllers (Type A-1, Other CC Types)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	TYPE A-1 CRATE CONTROLLER	1301	BI RA SYSTEMS	2	/73	
	CRATE CONTROLLER /ESONE TYPE A1/ (CONFORMS TO EUR4600 SPECS)	1502	BORER	2	/72	
	CRATE CONTROLLER TYPE CCA-1 ACCORDING TO EUR4600 SPECS WITH CERN OPTIONS	DO 200-2905	DORNIER	2	03/74	
	CAMAC CRATE CONTROLLER TYPE A-1 (CONFORMS TO EUR4600 SPECIFICATIONS)	CC101	EG&G/ORTEC	2	/72	
	ESONE TYPE A.1 CRATE CONTROLLER(CONFORMS TO EUR4600 SPECS, INCL CERN HOLD OPTION)	CC 2405	GEC-ELLIOTT	2	/73	
	CRATE CONTROLLER TYPE A-1 (CONFORMS TO EUR4600 SPECS)	CCA-1	JOERGER	2	/72	(5)
	BRANCH CRATE CONTROLLER/TYPE A-1 (CONFORMS TO EUR 4600 SPECS, 1972)	70A	JORWAY	2	/73	(7)
	TYPE A-1 CRATE CONTROLLER	3900	KINETIC SYSTEMS	2	/73	
	CRATE A-1 CONTROLLER (CONFORMS TO EUR 4600 SPECS)	9016	NUCL. ENTERPRISES	2		(4)
	CRATE CONTROLLER TYPE A (CONFORMS TO EUR4600 SPECS)	C 106	RDT	2	/71	
	CRATE CONTROLLER TYPE A-1 (CONFORMS TO EUR4600 SPECS)	J CRC 51	SCHLUMBERGER	2	/72	(1)
	A-1 CRATE CONTROLLER (CONFORMS TO EUR4600 SPECS, INCL CERN SPEC HOLD LINE)	ACC 2034	SEN	2	/72	
	CRATE CONTROLLER A1 (EUR 4600 SPECS AND CERN NOTE 38-00)	C 72451-A1446-A2	SIEMENS	2	/70	(1)
	TYPE A-1 (ESONE) CRATE CONTROLLER	CC-A1	STND ENGINEERING	2	/72	(6)
	TYPE A1 CONTROLLER WITH TERMINATOR (MEETS 4600 SPECS OF JAN 1972)	CCT-A1	STND ENGINEERING	2		
	CRATE CONTROLLER TYPE D (CONFORMS TO EUR 4100, USED WITH DO 280 COMPUTER SYSTEM)	DO 200-2901	DORNIER	2	/71	

232 Lam Graders

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	LAM GRADER (24 BIT MASK REGISTER, PLUG-IN PATCH BOARD, CERN 064)	LG 2401	GEC-ELLIOTT	1	/72	
	LAM GRADER (INTERNALLY PATCHABLE, SWITCH SELECTABLE MULTI-CRATE BG-RESPONSE)	LG	JOERGER	1	/73	(8)
C	LAM GRADER-SORTER	75	JORWAY	2	/73	(7)
	LAM GRADER (DESIGNED TO EUR 4600 SPECS)	064	NUCL. ENTERPRISES	1	/72	(4)
	PRIORITY GRADER	9037	NUCL. ENTERPRISES	1		(10)
	LAM GRADER (CERN SPECS 064)	C 107	RDT	1	/71	
	LAM GRADER (CERN SPECS 064)	LG 2001	SEN	1	/72	(6)

233 Terminations (Simple or with Indicators)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	BRANCH HIGHWAY TERMINATOR	6601	BI RA SYSTEMS	1	/73	
	TERMINATION UNIT (WITH BUILT-IN CABLE)	1592	BORER	1	/73	
	TERMINATOR MODULE (BRANCH HIGHWAY TERMINATOR)	TC024	EG&G/ORTEC	2	/71	
	BRANCH TERMINATION UNIT (NON INDICATING)	BT 6503	GEC-ELLIOTT	2	/72	
	BRANCH TERMINATION UNIT	BT 6601	GEC-ELLIOTT	2	/71	
	BRANCH TERMINATOR	BT	JOERGER	2	/72	
	BRANCH TERMINATION WITH INTEGRAL CABLE	50C	JORWAY	2	/72	
	BRANCH TERMINATOR IN A CONNECTOR	BT-01	KINETIC SYSTEMS	NA	/73	
	BRANCH TERMINATOR	J BT 20	SCHLUMBERGER	2	/71	

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	BRANCH TERMINATOR (NON-INDICATING, 40 CM FLYING CABLE WITH BRANCH CONNECTOR)	BT 231	SEMRA-BENNEY	1	04/74	
	(DITTO, XXX= CABLE LENGTH IN CM)	BT 231XXX		1	04/74	
	CRATE CONTROLLER BUS TERMINATOR FOR A-1 CRATE CONTROLLER	BT 2042	SEN	1	/72	
	BRANCH HIGHWAY TERMINATOR	BHT 2055	SEN	1	03/74	(11)
	BRANCH HIGHWAY TERMINATOR	BHT-001	STNC ENGINEERING	1	/73	
	BRANCH HIGHWAY TERMINATOR, WITH DISPLAY	BHT-002/D	STNC ENGINEERING	2	/73	
	BRANCH TERMINATOR (FULL BRANCH MONITOR WITH INTERNAL STORAGE AND LED DISPLAY)	BT 6502	GEC-ELLIOTT	2	/72	
	VISUAL BRANCH TERMINATOR (STORES AND DISPLAYS ON LEDS BRANCH SIGNALS)	VBT	JOERGER	2	/72	(6)
	BRANCH TERMINATION WITH BRANCH DISPLAY	51	JORWAY	2	/72	
	BRANCH TERMINATION UNIT (WITH INDICATOR AND POWER SUPPLY)	C 72451-A10-A1	SIEMENS	NA	/73	(3)

234 Branch Extenders, Bus Extenders

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	EXTENDED BRANCH SERIAL DRIVER	3998	KINETIC SYSTEMS	5	03/74	
	DIFFERENTIAL BRANCH EXTENDER (FOR EXTENDING BRANCHES UP TO 3 KM)	DBE 6501	GEC-ELLIOTT	2	/71	
	DIFFERENTIAL MODE BRANCH HIGHWAY EXTENDER (BI-DIRECTIONAL)	55	JORWAY	NA	/73	(7)
	BRANCH HIGHWAY TRANSCEIVER FOR LONG DISTANCE TRANSMISSION	J BHT 10	SCHLUMBERGER	2		(4)
	UNIBUS EXTENDER, TRANSMITTER	1594	BORER	2	/72	
	RECEIVER (FOR DISTANCES UP TO 200 METRE OR MORE)	1595		2	/72	

3 TEST EQUIPMENT

31 System Related test Gear

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	SYSTEM TEST UNIT (FOR EXECUTIVE SUIT SYSTEM CONFIGURATION, SEE MX-CTR-2)	SC-TST-1	GEC-ELLIOTT	3	/72	

311 Computer Simulators

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	PDP-11 SIMULATOR	6101	BI RA SYSTEMS	NA	/72	(5)
N	TEST CONTROLLER WITH PROGRAM PLUGBOARD	SPS 2048	NUCL. ENTERPRISES	2	01/75	

32 Branch Related Testers/Controllers and Displays

321 Branch Testers/Controllers (Manuel, Programmed)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	MANUAL BRANCH TESTER (TYPE A SYSTEM TEST SET WITH MX-CTR-2 & BR-CPR-2)	SC-TST-1	GEC-ELLIOTT	7		
	TEST MODULE (USED IN SYSTEM TEST OF READ/WRITE CAPABILITY)	TM024	EG&G/ORTEC	2	/71	
	BRANCH HIGHWAY TEST POINT MODULE(24 DIRECT,22 INDIRECT ACCESS POINTS FOR TEST)	CD 18104	EMIHUS	NA	/71	(3)
	BRANCH HIGHWAY REMOVE INHIBIT MODULE (REMOVES INHIBIT FROM BCR/BA/BF/BN/BTA)	CD 18105	EMIHUS	NA	/71	(3)
	MANUAL BRANCH DRIVER (FOR TESTING TYPE A SYSTEMS)	MBD	JOERGER	5	/72	(6)
	MANUAL BRANCH CONTROL SET (COMPRISING TYPES C COB 10 AND T CMB 10)	C CMB 10	SCHLUMBERGER	NA	/71	(1)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR

33 Dataway Related Testers and Displays

331 Dataway Controllers/Testers (Manual, Programmed)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	MANUAL CRATE CONTROLLER	GFK-LEM	EISENMANN	8	/71	
	MANUAL CRATE CONTROLLER	MCC	JOERGER	5	/72	
	MANUAL DATAWAY CONTROLLER	7024-1	NUCL. ENTERPRISES	8	/70	
	MANUAL DATAWAY CONTROLLER/DISPLAY SYSTEM	D AI 10	SCHLUMBERGER		/71	
	INTERFACE TO DATAWAY	J DA 10		1		
	CONTROL AND DISPLAY CRATE	C AI 10		NA		
	MANUAL CRATE CONTROLLER	J CMC 10	SCHLUMBERGER	8	/71	(1)
	TEST MODULE FOR CRATE CONTROLLER AND DATAWAY	DTM 2040	SEN	1	/72	
	MANUAL 24 BIT CRATE CONTROLLER	MCC-240	STND ENGINEERING	2	/72	(5)
	DYNAMIC TEST CONTROLLER (GENERATES ALL POSSIBLE CAMAC COMMANDS IN SINGLE CRATE)	TC 2403	GEC-ELLIOTT	3	/71	
	DYNAMIC TEST CONTROLLER (2 SIMULT TRANSF SINGLE, STEP-BY-STEP AND CONTINUOUS MODE)	C 108	RDT	8	/71	(4)
N	DATAWAY SERVICE MODULE	J DS 10	SCHLUMBERGER	1	/74	
	CONTROLEUR SORTIE DATAWAY (DATAWAY TEST MODULE)		TRANSRACK	1	/70	

332 Dataway Displays

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
C	CAMAC TEST MODULE/DATAWAY DISPLAY	6102	BI RA SYSTEMS	2	/73	
	CAMAC DATAWAY DISPLAY (DATAWAY SIGNAL PATTERN STORED/DISPLAYED, 2 TEST MODES)	1801	BORER	1	/71	(1)
	CAMAC DATAWAY TEST AND DISPLAY MODULE	LEM-52/16.2	EISENMANN	1		
	DATAWAY TEST MODULE (FULL DATAWAY MONITOR WITH INTERNAL STORAGE AND LED DISPLAY)	DTM 3	GEC-ELLIOTT	1	/72	
	DATAWAY MEMORY (DISPLAY + READABLE REGISTER)	C 340	INFORMATEK	1	/72	
	DATAWAY DISPLAY (STORES AND DISPLAYS DATAWAY SIGNALS, FARWQXCIZS1S2BF1P2)	DD	JOERGER	1	/72	(6)
N	DATAWAY DISPLAY (SEPARATE R & W DISPLAY, TRACKS OR STORES, MANUAL CLEAR)	202	JORWAY	1	/74	(11)
	DATAWAY DISPLAY	3290	KINETIC SYSTEMS	1	/72	
	DATAWAY DISPLAY	C 76451-A16-A1	SIEMENS	1	/73	(6)
	DATAWAY DISPLAY MODULE	DD-002	STND ENGINEERING	1	/72	(5)
C	DATAWAY DISPLAY (DISPLAYS AND STORES DATAWAY SIGNAL PATTERN)	C-D1-24	WENZEL ELEKTRONIK	1	/72	

34 Module Related Test Gear (Module Extenders)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	CAMAC MANUAL MODULE TESTER	6103	BI RA SYSTEMS	NA	/74	

341 Module Extenders

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	CAMAC EXTENDER MODULE	8201	BI RA SYSTEMS	1	/73	
	EXTENSION FRAME (MODULE EXTENDER)	EF 1-1	GEC-ELLIOTT	1	/71	
	MODULE EXTENDER (+AND-6V,+AND-24V FUSED, RETRACTABLE LOCKING DEVICE)	ME	JOERGER	1	/72	
	EXTENDER MODULE	11	JORWAY	1	/71	
N	EXTENDER MODULE (FUSED +&-6V AND +&-24V, SUPPORT ARM)	11A	JORWAY	1	/74	
	EXTENDER CARD	1109	KINETIC SYSTEMS	1	/71	(4)
	EXTENSION UNIT	7007-1	NUCL. ENTERPRISES	1	/70	
	EXTENDER MODULE	061	POLON	1	/73	
	EXTENDER	CEX	RDT	1	/72	
	MODULE EXTENDER	ME 2030	SEN	1	/70	
	EXTENDER (XXX=LENGTH OF CABLE IN MM BEYOND RACK, SINGLE WIDTH)	577/XXX	TEKDATA	1	/72	(5)
	EXTENDER (XXX=LENGTH OF CABLE IN MM BEYOND RACK, DOUBLE WIDTH)	5813/XXX		2	/73	

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	PROLONGATEUR POUR TIROIRS CAMAC (EXTENDER)		TRANSPACK	1	/70	

37 Other Test Gear for CAMAC Equipment

	TRANSIENT GENERATOR(MODULE NOISE SUSCEPT IBILITY TESTED BY TRANSIENTS ON DC LINES	TG	JCERGER	1	/73	

4 CRATES, SUPPLIES, COMPONENTS, ACCESSORIES

41 Crates and Related Components/Accessories — Crates with/without Dataway and Supply, Blank Crates, Crate Ventilation Gear

411 Crates with Dataway and Supply

	CRATF (270VA,COOLED,MODULAR POWERED BY UP TO 8 REGULATORS 1922 OR 1925+1922)	1902A	BORFR	25	/69	
	VOLTAGE REGULATOR (FOR +OR-24V/6A, +/-12V/7A,+/-6V/8A/16A24A)	1922			/69	
	VOLTAGE REGULATOR (+AND-6V, 25A MAX, 270W RATING, USABLE WITH 4X1922)	1925			/73	
	CAMAC MINICRATE (+6V/10A,-6V/10A,+24V/4A,-24V/4A,200W)		EDS SYSTEMTECHNIK	17	/73	
C	CAMAC MINICRATE (+6V/15A,-6V/5A, +24V/2A,-24V/2A,200W)	307.100CC	EDS SYSTEMTECHNIK	17	/73	(10)
	POWERED CRATF	MC200	EG&G/ORTEC	25	01/74	
	CONVERTS FASTON CONNECTORS TO RECOMMEND-ED FIXED POWER CONNECTOR ON CHOSEN CRATE	/AMP	GEC-ELLIOTT		/73	
	POWERED CRATE (+&-6V/40A, +&-24V/8A, 200V/.1A, 117V AC, MAX 300W)	CPU/11	GRENSON		/73	
	POWERED CRATE (SAME, WITHOUT MONITORING)	CPU/12			/73	
	POWERED CRATE	1500	KINETIC SYSTEMS	NA	/73	
	POWER CRATE (7005-2 CRATE WITH 9022 POWER SUPPLY)	9023	NUCL. ENTERPRISES	24	/71	(2)
	POWERED CRATE (+AND-6V/25A, +AND-24V/6A, (INCL POWER DESIGN TYPE AEC432 SUPPLY)	NSI-875CC100AEC432	NUCL. SPECIALTIES	25	/72	
	POWERED CRATE (6U,VENTILATED,NO FAN,130W +6V/15A,-6V/4A,+AND-24V/2A,+200V/50MA)		POLON	25	/71	
	POWERED CRATE	CCHN-CSAN	RDT	25	/71	
	POWERED CRATE(SEE P4 ALJ 13)	C4 ALJ 13 E	SAPHYMO-SRAT	25	/71	(1)
	POWERED CRATE(SEE P6 ALJ 13)	C6 ALJ 13 C		25		(1)
	POWERED CRATE(SEE P7 ALJ 13)	C7 ALJ 13 CW		25		(1)
	POWER SUPPLY (CAMAC CRATE)	CM5125/53/DW/BIP	SAPHYMO-SRAT	25	/72	
	POWER SUPPLY (CAMAC CRATE)	CM5125/53/AW/BIP		25		
	POWERED VENTILATED CRATE (+6V/24A, -6V/16A, +AND-24V/3A, MAX 400W)	C JAL-41	SCHLUMBERGER	25	/73	(8)
	POWER CRATE (200W MAX,+6V/25A,-6V/10A, +AND-12V/3A,+AND-24V/3A,200V/0.05A)	PC 2006/B	SEN	25	/70	
	POWER CRATE (200W MAX,+6V/25A,-6V/10A, +AND-24V/3A,200V/0.05A)	PC 2006/C		25	/71	
	POWERED CRATE (+6V/32A,-6V/32A,+24V/6A, -24V/6A,+200V/.1A,300W. POWER FAIL LAM)	PC 2057	SEN	NA	03/74	(11)
	POWERED CRATE (7U,VENT,+AND-6V/26A,+AND-12V/6.5A,+AND-24V/6.5A,200V/0.1A,200W)	C 76455-A2	SIEMENS	25	/71	(3)
	POWERED CRATE (SAME BUT WITH 117V AC)	C 76455-A1		25	/71	
	POWERED CRATE (+AND-6V/25A, +AND-24V/6A, OPTIONAL +AND-12V/3A,+AND-200V/0.1A)	PCS	STND ENGINEERING	25		(5)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR

412 Crates with Dataway, without Supply

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	VENTILATED CRATE (STANDARD 24 STATION FASTON CONNECTORS)	VC 0010	GEC-ELLIOTT	24	/70	
	VENTILATED CRATE (STANDARD 25 STATION FASTON CONNECTORS)	VC 0011	GEC-ELLIOTT	25	/72	
	VENTILATED CRATE (HEAVY DUTY 25 STATION FASTON CONNECTORS)	VC 0021		25	/72	
	CAMAC CRATE VERDRAHTET (EMPTY CRATE WITH WIRED DATAWAY)	2.084.000.6	KNUERR	25	/73	(2)
	CRATE	7005-2	NUCL. ENTERPRISES	24	/70	
	CAMAC COMPATIBLE CRATE (WIRED)	NSI-875 DP-WV	NUCL. SPECIALTIES	25	/71	
	CAMAC CRATE (WIRED)	NST-875 CC 100	NUCL. SPECIALTIES	25	/72	
	UNPOWERED CRATE WITH DATAWAY (6U, EMPTU, VENTILATED, NO FAN)	012	POLON	25	/71	
	UNPOWERED CRATE WITH DATAWAY ( )	CM 5125/33/AW	SAPHYMO-SRAT	25	/71	
	(360 MM)	CM 5125/33/DW		25		
	( )	CM 5125/53/AW		25		
	(525 MM)	CM 5125/53/DW		25		
	UNPOWERED CRATE WITH DATAWAY AND CONNECTORS	UPC 2029	SEN	25	/70	
	CRATE (WIRED CRATE)	WCS	STND ENGINEERING	25		(5)
	CRATE (WITH DATAWAY AND VENTILATION)	C 76455-A3	SIEMENS	25	/72	

417 Blank Crates and Other Components and Accessories

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	CRATE (5U,EMPTY, 25 STATIONS)	MCF/5CAM/S/25	IMHCF-BEDCC	25	/71	
	(SAME BUT WITH 24 STATIONS)	MCF/5CAM/S/24		24	/72	
	CRATE (6U,EMPTY,WITH VENTILATION BAFFLE, 25 STATIONS, HARWELL TYPE 7000)	MCF/6CAM/SV/25		25	/71	
	(SAME BUT WITH 24 STATIONS)	MCF/6CAM/SV/24		24	/72	
	CRATE (6U,EMPTY,WITH VENTILATION BAFFLE, REMOVABLE PANEL, 25 STNS, HARWELL 7000)	MCF/6CAM/SVR/25		25	/71	
	(SAME BUT WITH 24 STATIONS)	MCF/6CAM/SVR/24		24	/72	
	CAMAC CRATE (EMPTY)	2.080.000.6	KNUERR	25	/70	(2)
	CAMAC CRATE (EMPTY,INCL HARDWARE SUPPLY CHASSIS AND VENTILATION PANEL)	2.086.000.6		25		(2)
	CAMAC COMPATIBLE CRATE	NSI 875 DP/WV	NUCL. SPECIALTIES	25	/70	
	CAMAC CRATE (UNWIRED)	NSI 875 CC 100	NUCL. SPECIALTIES	25	/72	(5)
	CHASSIS CAMAC (6 UNITES AVEC FENTE DE VENTILATION, 525 MM PROFONDEUR)	9905-1-05	OSL	25	/71	
	(360 MM PROFONDEUR)	9905-2-05		25	/71	
N	CAMAC CRATE WITH VENTILATION BAFFLE (6U, 525MM DEPTH)	9905HVD3/98/525	OSL	25		
N	(SAME BUT WITH 460MM DEPTH)	99055HV3AVC/98/460		25		
N	(SAME BUT WITH 360MM DEPTH)	99055HV3AVC/98/360		25		
	CRATE (6U, EMPTY, VENTILATED, NO FAN)	010	POLON	25	/71	
	VENTILATED CRATE NO POWER NO DATAWAY (TWO FANS)	CCHN	RDT	25	/71	
	(SAME WITH 3 FANS)	CCHNA		25	/72	
	CAMAC CRATE (EMPTY CRATE)	C	STND ENGINEERING	25		
	CAMAC CRATE (EMPTY CRATE)	CS		25		
	CHASSIS CAMAC NORMALISE 5U (EMPTY CRATE,360 MM DEEP)	CM 5025 30	TRANSRACK	25	/70	
	(XX=40 FOR 460MM & =50 FOR 525MM DEEP)	CM 5025 XX		25		
	CHASSIS CAMAC 5U UTILES (EMPTY CRATE,6U TOTAL,360MM DEEP,VENTILATION HARDWARE)	CM 5125 30	TRANSRACK	25	/70	
	(XX=40 FOR 460MM & =50 FOR 525MM DEEP)	CM 5125 XX		25		
	CHASSIS CAMAC 5U UTILES (EMPTY CRATE, TOTAL 6U,360 MM DEEP,WITH ONE FAN)	CM 5125 31	TRANSRACK	25	/70	
	(XX=41 FOR 460MM & =51 FOR 525MM DEEP)	CM 5125 XX		25		
	CHASSIS CAMAC 5U UTILES (EMPTY CRATE,6U TOTAL,360MM DEEP,WITH TWO FANS)	CM 5125 32	TRANSRACK	25	/70	
	(XX=42 FOR 460MM & =52 FOR 525MM DEEP)	CM 5125 XX		25		
	CAMAC CRATE (EMPTY) HEAVY DUTY		OSL/WILLSHER&QUICK		/73	
	6U WITH VENTILATION BAFFLE	9905-5HV		25	/73	
	5U NON VENTILATED	9905-5H		25	/73	
	DEPTH OPTIONS 360MM, 460MM, 525MM					

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	CAMAC CRATE WITH VENTILATION BAFFLE (6U, 525MM DEPTH)	99055HV3AVD/98/525	OSL/WILLSHER&QUICK	25	/73	
	(SAME BUT WITH 460 MM DEPTH)	99055HV3AVC/98/460		25	/73	
	(SAME BUT WITH 360 MM DEPTH)	99055HV3AVC/98/360		25	/73	
	1U COOLING DRAWER (FOR CRATE ONLY, 2 FANS, FITS 6U CRATE)	CDR 1	GEC-ELLIOTT		/72	
	2U COOLING DRAWER (COOLS CRATE AND CRATE MOUNTED PS 0003,FAN+CONTROL PANEL INCL)	CDR 2	GEC-ELLIOTT		/72	
	VENTILATICN UNIT	CAM/FV	IMHOF-BEDCO		/73	
	LUFTEREINHEIT (VENTILATION UNIT,COMPLETE WITH 3 FANS AND FILTER)	2.081.000.6	KNUERR		/70	
	(VENTILATION UNIT,NO FAN,NO FILTER)	2.085.000.6				
	AIR SCOOP (STOPS CHIMNEY EFFECT BETWEEN UN-VENTILATED CRATES IN RACK, 1U HIGH)	NSI-12109-AS	NUCL. SPECIALTIES	NA	/71	
	FAN UNIT (FOR ALB/10 SUPPLY SYSTEM)	VALB/10	SAPHYMO-SRAT		/72	
	CRATE BLOWER UNIT		STNC ENGINEERING			(5)
	1U VENTILATION GRILL	1 UG	OSL/WILLSHER&QUICK		/72	

42 Supplies and Related Components/Accessories — Single- and Multi-Crate Supplies, Blank Supply Chassis, Control Panels, Supply Ventilation

421 Multi-Crate Supplies

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
C	POWER SUPPLY FLEXIBLE SYSTEM COMPRISING	CPU/10	GRENSON		/71	
	BASIC CRATE(FOR SUPPLY MODULES,INCLUDES REFERENCE,CONTROL AND 200V/0.1A)	CFC				
	SUPPLY MODULE(* IN TYPE = P FOR POS AND N FOR NEG OUTPUT VOLTAGE 6V/ 6A)	CF*/6				
	(12V/ 3A)	CF*/12				
	(24V/ 3A)	CF*/S4				
	POWER SUPPLY SYSTEM (CRATE) (MODULE OPTIONS AS FOLLOWS)	C4 BIP 203	SAPHYMO-SRAT		/72	
	POWER SUPPLY MODULE 6 V 10 A	BIP B6 10				
	6 V 15 A	BIP C6 15				
	6 V 20 A	BIP D6 20				
	6 V 40 A	BIP E6 40				
	12 V 7 A	BIP B12 7				
	12 V 10 A	BIP C12 10				
	12 V 15 A	BIP D12 15				
	12 V 25 A	BIP E12 25				
	24 V 3.5A	BIP B24 35				
	24 V 6 A	BIP C24 6				
	24 V 9 A	BIP D24 9				
	24 V 15 A	BIP E24 15				
	SUPPLY CHASSIS 2KW (RAW SUPPLY FOR REGULATOR MODULES)	ALB/10	SAPHYMO-SRAT		/73	(2)
	FAN UNIT	VALB/10				
	WIRED RACK 42 U	BC 42				
	POWER SUPPLY MODULE 6 V 5 A(REGULATOR)	BPR 605				
	6 V 10 A	BPR 610				
	6 V 25 A	BPR 625				
	12 V 2 A	BPR 122				
	12 V 5 A	BPR 125				
	24 V 3 A	BPR 243				
	24 V 5 A	BPR 245				

422 Single-Crate Supplies

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	COMPACT POWER SUPPLY UNIT (CRATE/PANEL MOUNT,+AND-6V/25A,+AND-24V/6A,200/300W)	PS 0003	GEC-ELLIOTT		/71	
	CAMAC POWER UNIT (+6V/15A,-6V/3A,+24V/2A -24V/2A,200V/0.05A,117VAC)	CPU/4	GRENSON			
C	CAMAC POWER SUPPLY - RACK MOUNTING (+6V/20A,-6V/5A,+AND-24V/5A,200V/0.05A)	CPU/2	GRENSON		/71	
C	CAMAC POWER SUPPLY - RACK MOUNTING (+6V/20A,-6V/5A, +&-12V/2A, +&-24V/3A)	CPU/5	GRENSON		/71	
	POWER SUPPLY (RACK MOUNTING,+6V/25A, -6V/15A,+AND-24V/5A,200V/0.1A)	CPU/6	GRENSON		/71	
	POWER SUPPLY (RACK MOUNTING,+6V/25A, -6V/15A,+AND-24V/5A,+AND-12V)	CPU/7	GRENSON		/71	
	POWER SUPPLY (+6V/20A,-6V/5A, +AND-24V/5A,200V/0.05A)	9001	NUCL. ENTERPRISES		/71	
	POWER UNIT (+6V/15A,-6V/3A, +AND-24V/2A,200V/0.05A)	9022	NUCL. ENTERPRISES		/71	(2)
	POWER SUPPLY (RACK MOUNTING,+6V/15A, -6V/4A, +AND-24V/2A,+200V/50MA,130W)	CZC-10	POLON		/73	

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	POWER UNIT (+6V/20A, -6V/15A,+24V/2A, -24V/2A,200V/0.1A)	SP 426	POWER ELECTRONICS		/74	
	POWER SUPPLY (+6V/25A,-6V/5A, +AND-12V/2A,+AND-24V/3A,200V/0.1A)	C 303	RDT		/71	
	POWER SUPPLY UNIT (+6V/10A,-6V/2A,+AND-24V/1.5A)	P4 ALJ 13	SAFHYMO-SRAT		/71	
	(+6V/5A,-6V/1.5A,+AND-12V/1.5A, +AND-24V/1.5A)	P5 ALJ 13				
	(+6V/25A,-6V/10A,+AND-12V/3A, +AND-24V/3A,+200V/0.1A,MAX 200W)	P7 ALJ 13				
	SUPPLY (+AND-6V/26A,+AND-12V/6.5A,+AND- 24V/6.5A,200V/0.1A,117V AC, 200W MAX)	C 76455-A4	SIEMENS		/72	
	SUPPLY (SAME BUT WITHOUT 117V AC)	C 76455-A5			/72	
	POWER SUPPLY AND BLOWER UNIT	1410 S	STND ENGINEERING			(5)
	POWER SUPPLY (+AND-6V/6A SHARED AND +AND-24V/2A SHARED, METERING OF V AND I)	825	STND ENGINEERING			

427 Blank Supply Chassis, Other Components/Accessories

	POWER SUPPLY CRATE (STANDARD)	MCF/4/PPC	IMFCF-BEDCC	NA	/71	
	POWER SUPPLY CRATE (WIRED)	MCF/PPC/WV		NA	/71	
	NETZTEILCHASSIS (EMPTY SUPPLY CHASSIS)	2.0 2.000.6	KNURR		/70	
	POWER SUPPLY CRATE(FOR SEPARATE SUPPLY)	CSAN	RDT		/71	
	VOLTAGE MONITOR PANEL USING LEDS	MP 2	GEC-ELLIOTT	1	/72	
	MAINS SWITCH ASSEMBLY	MS 3	GEC-ELLIOTT	NA	/71	
	POWER SUPPLY MONITOR PANEL (WITH MAINS SWITCH, TEST POINTS AND LED INDICATION)	PSMP 1	GEC-ELLIOTT	NA	/72	
	POWER INDICATOR	0704	NUCL. ENTERPRISES	NA	/70	

43 Recommended or Standard Components/Accessories — Branch Cables, Connectors etc., Dataway Connectors, Boards etc., Blank Modules, Other Stnd Components

431 Branch Related (Cables, Connectors etc.)

	BRANCH HIGHWAY CABLE	8102	BI RA SYSTEMS		/73	
	BRANCH HIGHWAY CABLE	BH001	EG&G/ORTEC		/71	
	BRANCH HIGHWAY CABLE ASSEMBLY (WITH CONNECTORS,27 CM LONG)	CC 66 POL FB-27	EMIHUS		/71	
	(XX CM LONG,PVC JACKET)	CC 66 POL FB-XX				
	BRANCH HIGHWAY CABLE (COMPLETE PTFE CABLE ASSEMBLY,27CM LONG)	CD 18067-27	EMIHUS		/70	
	(***= 107, 207 - OR CUSTOMER SPECIFIED - FOR CORRESPONDING LENGTH IN CM)	CD 18067/***			/71	
	BRANCH HIGHWAY CABLE (WITH CONNECTORS, 27 CM LONG)	BHC 027	GEC-ELLIOTT		/72	
	SAME,***=067,107 & 207 FOR CORRESP LENGTH IN CM,OTHER LENGHTS TO SPEC ORDER	BHC ***			/72	
	BRANCH HIGHWAY CABLE		JOERGER			
	BRANCH CABLE WITH CONNECTOR (1.5 FT TO 75 FT LONG)		JORWAY		/71	
	BRANCH HIGHWAY CABLE (66 TWISTED PAIRS)	CL 90	SCHLUMBERGER		/71	
	BRANCH HIGHWAY CABLE ASSEMBLY (COMPLETE WITH CONNECTORS, LENGTH 27 CM)	BHC 27	SEMRA-BENNEY		/72	
	(SAME, XXX=LENGTH IN CM, 040,100 ETC)	BHC XXX			/72	
	BRANCH HIGHWAY CABLES(COMPLETE WITH CONNECTOR,XXX = LENGTH IN METERS)	2000/S/132/XXX	TEKDATA		/71	(4)
	BRANCH HIGHWAY CONNECTOR (FREE MEMBER, PIN MOULDING WITH METAL PIN PROTECTOR)	WSS0132P08EN527-M	EMIHUS		/73	
	BRANCH HIGHWAY CONNECTOR (FIXED MEMBER,SOCKET MOULDING)	WSS0132S00EN000	EMIHUS		/70	
	(FREE MEMBER,PIN MOULDING, PXX YYY SELECTS JACKSCREW)	WSS0132PXXENYYY				
	HOOD (FOR FREE MEMBER)	WAC 0132 H005				
	BRANCH HIGHWAY CABLE ONLY (PLAIN PVC JACKET)	66 POL PB	EMIHUS		/71	
	EXTENDED BRANCH CABLE (LOW COST TELE- PHONE CABLE FOR LONG BRANCH RUNS)	EBC XXXX	GEC-ELLIOTT		/72	
	BRANCH HIGHWAY CABLE (132-WAY)	LIY-Y72X2X0.088	LEONISCHE		/72	
	BRANCH HIGHWAY CABLE (TRUE 132-WAY WITH METALISED POLYESTER SCREEN, PVC JACKET)	LI2Y(ST)Y66X2X0.18	LEONISCHE			

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	CABLE FOR BRANCH HIGHWAY (PVC JACKET)	132 PE 189	PRECICABLE EOUR		/71	
	(BRAIDED RILSAN JACKET)	132 PF 210				
	(MEPLAT 20MMX10.8MM,GAINE PVC NOIR)	132 PE 291			/72	
	CABLE EXTENSION MODULE (JOINS TWO BRANCH HIGHWAY CABLES)	CD 18106	EMIHUS		/72	
	BRANCH HIGHWAY TO PDP-11 (COMPLETE WITH CONNECTORS, XXX= LENGTH IN METERS)	5805/P/132/XXX	TEKDATA		/73	(8)

432 Dataway Related (Connectors, Boards, Assemblies)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	DATAWAY MOTHERBOARD (MULTILAYER PNB)	DM-1	STND ENGINEERING			
	DATAWAY MOTHERBOARD (WITH CONNECTORS)	1186	WEHRMANN		/74	(10)
	DATAWAY SOCKET (MOTHERBOARD COMPLETE WITH 25 CONNECTORS)	CIM	RDT		/70	
	DATAWAY MINI WRAPPING (MOTHERBOARD WITH 25 DATAWAY CONNECTORS)	J/DW	SAPHYMO-SRAT		/71	
	CAMAC MULTILAYER (DATAWAY MOTHERBOARD)	CM-8-69	TECH AND TEL		/71	
	DATAWAY CONNECTOR, EDGE TYPE II	1-163633-0	AMP AG		/70	
	(WIRE WRAP)					
	(TERMI-POINT/WIRE WRAP)	1-163634-0			/70	
	(MOTHERBOARD SOLDER)	1-163635-0			/70	
	(WIRE SOLDER)	1-163636-0			/70	
N	DATAWAY CONNECTOR WITH CARD GUIDES (HAND SOLDER, DIP SOLDER & MINI-WRAP)	PBC SERIES	BURNDY	NA	/74	
	DATAWAY CONNECTOR,FLOWSOLDER TERMINATION	R500014800000000	CARR FASTENER		/70	
	(ADD MOUNTING BRACKETS R500014900000000)					
	MINI WRAP TERMINATION	R500016801000000			/70	
	SOLDER SLOT TERMINATION				/70	
	DATAWAY CONNECTOR (MINIWRAP)	EAA 043 D301	EMIHUS		/71	(2)
	CONNECTEUR,FUTS DROITS (DATAWAY CONNECTOR,STRAIGHT PINS)	KF86 254 BED T	FRE CONNECTRON		/70	
	FUTS WRAPPING (WIRE WRAP PINS)	KF86 254 BEY T				
	FUTS A SOUDER (SOLDER PINS)	KF86 254 BES T				
	CAMAC DATAWAY CONNECTOR (* INSERT A FOR SOLDER TAG, B SOLDER PIN, C MINI WRAP)	G030 086P 2B * BL	ITT CANNON		/73	(6)
	CAMAC-LEISTE(DATAWAY CONNECTOR,WIREWRAP)	4.000.060.0	KNUERR		/70	
	DATAWAY FEMALE CONNECTOR, MINI-WRAP	2422 061 64334	PHILIPS		/71	(5)
	*=1 FOR WIRE SOLDER, 5 FOR BOARD SOLDER	2422 061 643*4				(5)
	DATAWAY MALE CONNECTOR (MATING THE CRATE MOUNTED 86-WAY CONNECTOR SOCKET)	2422 060 14314	PHILIPS		/72	(5)
	CONNECTEUR 254 DOUBLE FACE (DATAWAY CONNECTOR,WIRE WRAP)	254 DF 43 AWV	SOCAPEX		/70	
	(MOTHERBOARD SOLDER)	254 DF 43 AYV			/70	
	(WIRE SOLDER)	254 DF 43 AZV			/70	
	DATAWAY CONNECTOR (MINI-WRAP)	8606 86 21 15 000	SOURIAU		/71	
	(WIRE-SOLDER)	8606 86 21 10 000				
	(FLOW SOLDER)	8606 86 21 14 000				
	DATAWAY CONNECTOR (*=2 FLOW SOLDER,*=3 SOLDER LUGS,*=4 MINIWRAP,AU PLATING)	C 288* CSP 221	UECL		/71	
	(FLOW SOLDER,NI + AU PLATING)	C 2885 CSP 221				
	(13 MINIWRAP CONTACTS,OTHER ARE FLOW SOLDER,NI + AU PLATING)	C 2886 CSP 221				
	(*=7 MINIWRAP,*=8 SOLDER LUGS, NI + AU PLATING)	C 288* CSP 221				
	MOUNTING BRACKETS FOR ABOVE	C 8523				

433 Module Related (Blank Modules, Patchboards etc.)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	CAMAC CARRYING CASE (TAKES 8 MODULES)	C/NCC8-4	HENESA		/73	
	CAMAC CARRYING CASE (TAKES 12 MODULES	C/NCC12-6	HENESA		/73	
	BLANK MODULE KIT (SINGLE WIDTH)	BM 1	GEC-ELLIOTT	1	/73	
	NEW SIMPLIFIED DESIGN					
	(SAME,*=2,3 & 4 FOR CORRESP WIDTH)	BM *				
	SINGLE CARD MOUNTING KIT (EMPTY MODULE)	BCK/5CAM/CM1	IMHOF-BEDCO	1	/71	
	(SAME, *=2,3 & 4 FOR CORRESP WIDTH)	BCK/5CAM/CM*				
	DOUBLE ENCLOSED BIN KIT (EMPTY MODULE)	BCK/5CAM/BM2	IMHOF-BEDCO	2	/71	
	(SAME, *=3 & 4 FOR CORRESP WIDTH)	BCK/5CAM/BM*			/71	
	SINGLE CARD MOUNTING KIT (EMPTY MODULE,SHORT SCREEN PLATE)	CAM/M1/A	IMHOF-BEDCO	1	/72	
	(SAME,*=2,3 & 4 FOR CORRESP WIDTH)	CAM/M*/A			/73	
	SINGLE CARD MOUNTING KIT (EMPTY MODULE,	CAM/M1/B		1	/72	
	(EMPTY MODULE,LONGT SCREEN PLATE)					
	(SAME,*=2,3 & 4 FOR CORRESP WIDTH)	CAM/M*/B			/73	
	CAMAC HARDWARE	CH-001	KINETIC SYSTEMS	1	/71	(4)

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	CAMAC-KASSETTE (EMPTY MODULE,WIDTH 1/25) (*=2,3,4,5,6 FOR CORRESPONDING WIDTHS)	2.090.001.8 2.090.00*.8	KNUERR	1	/70 /70	(2)
	CAMAC COMPATIBLE MODULE (EMPTY, WIDTH=1, ALSO IN 2 & 3 UNIT WIDTHS)	NSI 875 DM	NUCL. SPECIALTIES	1	/70	
	CAMAC MODULE (EMPTY MODULE HARDWARE) (SAME, *= 2, 3, & 4 FOR CORRESP WIDTH)	NSI 875 CM-100-1 NSI 875 CM-100-*	NUCL. SPECIALTIES	1	/72 /72	(5) (5)
	CAMAC MODULE,SHIELDED (EMPTY, 1 WIDTH) (SAME, *=2, 3, AND 4 FOR CORRESP WIDTH)	NSI-875-DM/SPH-1 NSI-875-DM/SPH-*	NUCL. SPECIALTIES	1	/71 /71	
	CAMAC MODULE (EMPTY,W=1/25) (*=2,3,4,6 & 8 FOR CORRESP WIDTH) (*=0&2 FOR WIDTH 10 & 12 RESPECTIVELY)	021 02* 03*	POLON	1	/71 /71 /71	
	EMPTY MODULE 1 UNIT (SAME,*=2,3 & 4 FOR CORRESP WIDTH)	CCA 1 CCA *	RDT	1	/70	
	EMPTY MODULE SCREENED (1 WIDE, ADD TYPE SUFFIX A FOR SHORT, B FOR LONG SCREENS) (DITO, *=2,3,4 OR 6 FOR CORRESP WIDTH)	CM1 CM*	SEMRA-BENNEY	1	/73	
	MODULE HARDWARE (EMPTY MODULE, W=1/25, ALSO AVAILABLE W=2/25,3/25 & UP TO 8/25)		STND ENGINEERING	1		
	TIROIR MODULAIRE (EMPTY MODULE,W=1/25) (*=2,3,4 & 5 FOR CORRESPONDING WIDTH)) (**=06,08,10 AND 12 FOR CORRESP WIDTH)	TM 50125 TM 50*25 TM 5**25	TRANSRACK	1	/70	
	CAMAC MODULE (EMPTY,1/25 CARD MODULE) (*=2,3 & 4 FOR CORRESPONDING WIDTH)	CAMCAS 1 CAMCAS *	WILLSHER & QUICK	1	/71	(2) (2)
	CAMAC MODULE (EMPTY,1/25 CARD MODULE) (*=2,3 & 4 FOR CORRESPONDING WIDTH)	CAMCAS 1-G CAMCAS *-G	WILLSHER & QUICK	1	/72 /72	
	CAMAC MODULE(EMPTY,1/25 SCREENED MODULE) (*=2,3 & 4 FOR CORRESPONDING WIDTH)	CAMMOD 1-G CAMMOD *-G	WILLSHER & QUICK	1	/72 /72	
	CAMAC MODULE(EMPTY,2/25 SCREENED MODULE) (*=3 & 4 FOR CORRESPONDING WIDTH)	CAMMOD 2 CAMMOD *	WILLSHER & QUICK	2	/71	(2) (2)
	EMTY MODULE WITH HINGED CARDS (2/25) (3/25)	9905-CB2 9905-CB3	OSL/WILLSHER&QUICK	2 3	/73 /73	
	EMPTY MODULE (1/25) (**= T2, T3, T4, T5, T6, T8, T10, AND T12 FOR CORRESPONDING WIDTH)	9905-5T1 9905-5**	OSL/WILLSHER&QUICK	1	/73 /73	
	TIROTR MODULAIRE POUR COMMANDE	9905-TC-1	OSL	1	/71	
	TIROIR MODULAIRE DE COMMANDE (SUPPLY CONTROL MODULE)	TCM 525	TRANSRACK	1	/70	
	BLANK CAMAC MODULE PC BOARD (GOLD PLATED & ETCHED FINGERS BOTH SIDES)	NSI-04071-FC	NUCL. SPECIALTIES		/71	
	GENERAL-PURPOSE IC PATCH BOARD	18605	VERO ELECTRONICS		/74	
	MK-1 KLUGE MODULE (131 MIXED 14, 16, 24 PIN SOCKETS)	8301	BI RA SYSTEMS	2	/73	
	MK-5 KLUGE MODULE (HAS 70 14 PIN, 13 AND 2 24 PIN WIRE WRAP SOCKETS)	8305		2	/73	
	MK-6 KLUGE MODULE (HAS 34 14 PIN, 16 16 PIN & 3 24 PIN WIRE WRAP SOCKETS)	8306		1	/73	
	CAMAC-UNIVERSAL-BOARD(PRINTED CARD MODU- LE WITH 28 14-PIN + 28 16-PIN SOCKETS)	DO 200-2900	DORNIER	2	/71	
	CAMAC PROTOTYPE ASSEMBLY BOARDS (MX B1 HAS 68 SITES, MX B2 HAS 80 SITES)	MX B1/MX B2	GEC-ELLIOTT	NA	/71	
	(MX B3 HAS 68 SITES,MX B4 HAS 80 SITES, MX B3/MX B4 INCLUDE 5V CIRCUIT)	MX B3/MX B4		NA	/71	
	GENERAL PURPOSE IC PATCHBOARD (MAX 33 14/16-PIN AND 5 24-PIN DIP,WIRE WRAP)	CAMAC CG 164	GSFK	NA	/70	(2)
	PRINTED CIRCUIT TEST BOARD	10	JORWAY	NA	/71	
	KLUGE CARD (FOR CREATING YOUR OWN CAMAC MODULES)	2000-36	KINETIC SYSTEMS	1	/71	(4)
	KLUGE CARD	2006		1	/73	
	EXPERIM NTIERPLATTE (PRINTED CIRCUIT BOARD)	4.000.087.0	KNUERR	NA	/70	
	EXPERIMENTIERPLATTE (P.C.B.)	4.000.088.0		NA	/73	
	DECODED MATRIX BOARD (FOR PROTOTYPE WIRING OF 64 14-PIN SITES, A&F DECODED)	D 21 621	NUCL. ENTERPRISES	0	06/74	
	MODULE PRINTED CIRCUIT BOARDS(TAKE 24,16 OR 14 PIN, ON THE WHOLE 1092 PINS)	CBP 1	RDT	NA	/72	
	(SAME, WITH MINI-WRAP TO 0V AND +6V)	CBP 2		NA	/72	
	BLANK MODULE(COMPLETE WITH PRINTED BOARD FOR 69 INTEGRATED CIRCUITS,1 U WIDTH)	BM 2020/1U	SEN	1	/70	
	(SAME,2U WIDTH)	BM 2020/2U		2	/70	
	EXPERIMENT PLATE	C 72468-A453-A1	SIEMENS	1	/72	

437 Other Recommended or Standard Components/Access.

NC	DESIGNATION & SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	NIM ADAPTOR	7009-2	NUCL. ENTERPRISES	NA	/70	
	NIM-CAMAC ADAPTOR	CAN	RDT	NA	/71	
	NIM/CAMAC ADAPTOR	ANC 10	SCHLUMBERGER		/72	
	CAMAC NIM ADAPTOR	CNA 2033	SEN	2	/71	
	LAM GRADER CABLE (20CM, WITH CONNECTORS) (40CM, WITH CONNECTORS)	LGC 20 LGC 40	GEC-ELLIOTT		/72 /72	
	LAM GRADER CABLE		JOERGER			
	52 WAY CANNON 20B52S HARNESSES LAM GRADER CABLE, XXX= LENGTH IN METERS)	5809/S/52/XXX	TEKDATA		/73	
	LAM GRADER CONNECTOR (52-PIN FIXED MEMBER, TAKES PIN TYPE 031-9540-000)	2 DB 52 P	ITT CANNON		/70	
	COAXIAL CONNECTOR (PANEL MOUNTING. CABLE CONNECTOR HAS TYPE F 00.250 & FS 00.250)	RA 00.250	LEMO		/70	(4)

INDEX OF MANUFACTURERS

AEG-Telefunken
Elisabethenstrasse 3, Postfach 830
D-7900 Ulm, Germany

AMP AG
Haldenstrasse 11
CH-6000 Luzern, Switzerland

N Applied Computer Systems Ltd.
2nd Shorltonstreet
Manchester N. 13JL, England

C BF Vertrieb GmbH
(Sales of F & H Products in Germany
Bergwaldstrasse 30, Postfach 76
D-7500 Karlsruhe 41, Germany
see also Frieseke & Hoepfner

BI RA Systems, Inc.
3520 D Pan American Freeway, N.E.
Albuquerque, N. Mex. 87107, USA

Borer Electronics AG
Postfach
CH-4500 Solothurn 2, Switzerland

N Burndy Electra AG
Hertistrasse 23
CH-8304 Wallisellen, Switzerland

Cannon Electric GmbH
Bureau Schweiz
Friedenstrasse 15
CH-8304 Wallisellen, Switzerland

Carr Fastener Co. Ltd.
Cambridge House, Nottingham Road,
Stapleford, Nottinghamshire,
England

Digital Equipment Corporation (DEC)
146 Main Street
Maynard, Mass. 01754, USA

Digital Equipment Corporation SA
81, Route de l'Aire
CH-1227 Carouge-Genève, Switzerl.

Dornier AG
Vertrieb Elektronik, Abt. VCE
Postfach 648
D-799 Friedrichshafen, Germany

EDS Systemtechnik GmbH
Trierer Strasse 281
D-5100 Aachen, Germany

EG & G/ORTEC Inc.
High Energy Physics Dept.
500 Midland Road
Oak Ridge, Tenn. 37830, USA

J. Eisenmann Elektronik für
Prozessautomatisierung
Vogesenstrasse 6
D-7501 Blankenloch-Büchig,
Germany

Elliott – See GEC-Elliott

Emihus Microcomponents Ltd.
Clive House
12-18 Queens Road
Weybridge, Surrey, England

Emihus Microcomponents Ltd.
Belgian Branch
Res. Hera—Appt. No. 64
Passage International, 29
B-1000 Bruxelles, Belgium

FRB Connectron
3-5, Rue des Tilleuls
F-92600 Asnières, France

C Frieseke & Hoepfner GmbH
Export Dept. & Production
Tennenloher Strasse
D-8520 Erlangen-Brück, Germany
see also BF Vertrieb
(Sales of F & H Products in Germany)

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Leicester LE3 1UF, England

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1055 South East Street, Anaheim,
California 92805, USA

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England

GSPK (Electronics) Ltd.
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Harrogate, Yorks HG2 7BU, England

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Ampfingstrasse 27
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High Energy & Nuclear Equipment SA
2, Chemin de Tavernay,
CH-1218 Grand-Saconnex, Switzerl.

Hytec Electronics
225 Courthouse Road
Maidenhead, Berkshire, England

N IDAS (Informations-, Daten- und
Automationssysteme) GmbH
Kornmarkt 9
D-6250 Limburg/Lahn, Germany

C IMHOF-Bedco Ltd.
Colne Way Trading Estate, By-Pass
Watford, Herts, England

C INFORMATEK
Z.A. De Courtabœuf
B.P. 81
F-91401 Orsay, France

ITT Cannon – See Cannon

J and P Engineering (Reading) Ltd.
Portman House
Cardiff Road
Reading, Berkshire RG1-8JF, England

Joerger Enterprises
32 New York Avenue
Westbury, N.Y. 11590, USA

Jorway Corporation
27 Bond Street
Westbury, N.Y. 11590, USA

Kinetic Systems Corporation
Maryknoll Drive,
Lockport, Ill. 60441, USA

Knuerr – See Hans Knuerr

Laben (Division of Montedel)
Via Edoardo Bassini, 15
I-20133 Milano, Italy

LeCroy Research Systems Corp.
126 North Route 303
West Nyack, N.Y. 10994, USA

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81, Avenue Casai
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Switzerland

Lemo SA
CH-1110 Morges, Switzerland

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Abholfach
D-8500 Nürnberg 2, Germany

LRS-LeCroy – See LeCroy

Nano Systems
837, North Cuyler Avenue
Oak Park, Ill. 60302, USA

Nuclear Enterprises Ltd.
Bath Road
Beenham, Reading RG7 5PR, England

Nuclear Specialties Inc.
6341 Scarlett Court,
Dublin, California 94566, USA

N NUCLETRON SA
11, Chemin G. de Prangins
CH-1004 Lausanne, Switzerland

N ORTEC GmbH
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D-8000 München 40, Germany

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18bis, Avenue du Général de Gaulle
F-06340 La Trinité, France

OSL/Willsher and Quick -- See OSL
respectively Willsher and Quick

Packard Instrument Company, Inc.
Subsidiary of AMBAC Industries, Inc.
2200 Warrenville Rd.
Downers Grove, Ill. 60515, USA

Philips N.V., Dep. Elcoma
Interconnection Group, Building BA
Eindhoven, Netherlands

Polon
Nuclear Equipment Establishment
00-086 Warsaw, Bielanska 1, Poland

Polon – See also Zjednoczone

Power Electronics (London) Ltd.
Kingston Road Commerce Estate
Leatherhead, Surrey, England

Precicable Bour
151, Rue Michel-Carre
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RDT Ing. Rosselli Del Turco
Rossello S.L.R.
Via di Tor Cervara, 261
Roma Nomentano,
I-00155 Roma, Italy

SABCA – See Emihus, Belgian Branch

Saip – See Schlumberger

Saphymo-Srat
51, rue de l'Amiral Mouchez
F-75013 Paris, France

Schlumberger Instruments
& Systèmes
Dépt. Instrumentation Nucléaire
B.P. 47, (57, rue de Paris)
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Semra-Benney (Electronics) Ltd.
Industrial Estate,
Chandler's Ford, Eastleigh,
Hampshire SO5 3DP, England

SEN Electronique
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CH-1211 Genève 13, Switzerland

Siemens AG
Bereich Mess- und Prozesstechnik
Postfach 21 1080
D-7500 Karlsruhe 21, Germany

SOCAPEX (Thomson-CSF)
9, Rue Edouard Nieuport
F-92153 Suresnes, France

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13, Rue Gallieni, B. P. 410
F-92 Boulogne-Billancourt, France

Standard Engineering Corp.
44800 Industrial Drive,
Fremont, California 94538, USA

Tech and Tel – See Technograph

Techcal - See Stnd Engineering

Technograph and Telegraph Ltd.
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Bracknell, Berkshire, England

Tekdata Ltd.
Westport Lake, Canal Lane,
Tunstall, Stoke-on-Trent,
Staffs ST6 4PA, England

Tektronix, Inc.
P.O. Box 500, Beaverton,
Oregon 97005, USA

Telefunken – See AEG-Telefunken

TMA Electronics—See BI RA Systems

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22, Avenue Raspail
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Vero Electronics Ltd.
Industrial Estate, Chandler's Ford,
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Karl Wehrmann, Industrievertr.
Spaldingstrasse 74
D-2000 Hamburg 1, Germany

C Wenzel Elektronik
Wardeinstrasse 3
D-8000 München 82, Germany

Wenzel Elektronik (UK) Ltd.
Arndale House, The Precinct
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Willsher and Quick Ltd.
Walrow
Highbridge, Somerset, England

Willsher and Quick GmbH
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D-4054 Nettetal 2, Germany

Zjednoczone Zaklady Urzadzen
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Pl-00-086 Warszawa,
Bielanska 1, Poland

CAMAC SOFTWARE PRODUCTS GUIDE

INTRODUCTION

The Software Products Section of the CAMAC Products Guide lists a number of software packages, programs and routines which have been developed by software firms, manufacturers of CAMAC equipment, and at research laboratories.

Work is going on to implement IML — the intermediate level CAMAC language. One contribution to IML implementation is listed below, but at least five other laboratories are at present engaged in implementing IML on several computers.

The products listed below are either in current use or will be so in the nearest few months. Some of the software listed is commercially available, information about other is presumably available from respective authors. The correctness of each entry has been carefully checked against data provided.

Inclusion in the list does not necessarily indicate endorsement, recommendation or approval by the ESONE Committee, nor does omission indicate disapproval.

The classification used tentatively and reproduced below, is the same as was proposed in the March 1974 issue (No. 9) of this Bulletin.

SOFTWARE CLASSIFICATION GROUPS

INDEX OF CAMAC SOFTWARE PRODUCTS

.50 Fundamental Concepts, General Subjects

CLASS- - - - .50
TITLE- - - - IMPLEMENTING CAMAC BY COMPILERS
AUTHOR(S)- - W. KNEIS, GFK, ZYKLOTRON-LB.,
KARLSRUHE, GERMANY
PUBL. REF.-- PROC CAMAC SYMPOS, LUXEMBG, DEC 1973

DESCRIPTION--
DEMANDS ON REAL-TIME SYSTEMS SUCH AS MINIMUM EXECUTION TIME MINIMUM CORE REQUIREMENTS, ETC., RECOMMEND THE USE OF COMPILERS IN PROGRAMMING, THE POSSIBILITY TO IMPLEMENT A CAMAC LANGUAGE BY A COMPILER IS FIRST OF ALL A FUNCTION OF THE LEVEL AND CONCEPT OF THE LANGUAGE. META-LANGUAGES, THE SYNTAX OF A PROGRAMMING LANGUAGE, ARE USED TO FORMULATE A COMPILER FOR A SPECIFIC LANGUAGE. THE METHOD DESCRIBED HAS BEEN USED TO WRITE A COMPILER FOR IML, THE INTERMEDIATE LEVEL CAMAC LANGUAGE, IMPLEMENTED IN AN ASSEMBLER ENVIRONMENT.

CLASS- - - - .50
TITLE- - PROCEDURE CALLS - A PRAGMATIC APPROACH
AUTHORS-- J. MICHELSON, H. HALLING, KFA, JUELICH
PUBL. REF.-- PROC CAMAC SYMPOS, LUXEMBG, DEC 1973

ESONE REGSTR DATE- 31 MAY 1974

DESCRIPTION--
DISCUSSION OF PROCEDURE CALLS AS THE BASIS FOR CAMAC SOFTWARE WITHIN HIGH-LEVEL LANGUAGES. COMPARISON WITH SYNTAX MODIFICATIONS TO LANGUAGES. DISCUSSION OF IMPLEMENTATION RESTRICTIONS DUE TO LANGUAGE REQUIREMENTS FOR EXISTING HIGH-LEVEL LANGUAGES, E.G. CLOSED SYSTEM-SUBROUTINES WHICH EXECUTE ONE DEFINED OPERATION (INVOLVING ONE OR MORE CAMAC CYCLES AS A GROUP). COMPARISON OF US-NIM CAMAC FORTRAN SUBROUTINES AND PROCEDURE-CALL SYNTAX OF ESONE SWG IML LANGUAGE. APPLICATION OF PROCEDURE-CALLS TO APPLICATION-ORIENTED SOFTWARE.

CLASS- - - - .501(PL-11)
TITLE- - - - CAMAC FACILITIES IN THE PROGRAMMING LANGUAGE OF PL-11
AUTHOR - - - ROBERT D RUSSELL, CERN, GENEVA
PUBL. REF.-- PROC CAMAC SYMPOS, LUXEMBG, DEC 1973
NAME- - - - EXTENDED PL-11
OPERATIVE DATE- 1971/72
COMPUTER- - PDP-11
INTERFACE - - - - CA-11 (EG&G/ORTEC)
WORD LENGTH IS 16 BITS
SOFTWARE TYPE-- LANGUAGE, PL-11(EXTENDED)
INCORP TECHNIQUE.-
IN-LINE CODING OF CAMAC STATEMENTS
FACILITIES-- SYMBOLIC DEVICE NAMES USED,
DEMAND HANDLING INCLUDED.

DESCRIPTION--
PL-11 IS AN INTERMEDIATE-LEVEL, MACHINE-ORIENTED PROGRAMMING LANGUAGE EXTENDED TO INCLUDE CAMAC FEATURES. SYNTACTIC FORM OF CAMAC STATEMENTS ARE ANALOGOUS TO STANDARD PL-11 STATEMENTS. SYMBOLIC NAMES FOR VARIABLES AND FUNCTIONS ARE DECLARED AT ONCE, AND OPERATIONS ARE EXECUTED BY STATEMENTS REFERRING TO THESE NAMES. USE OF SYMBOLIC NAMES MAKES PROGRAMS READABLE, AND SIMPLIFIES MODIFICATIONS OF CAMAC CONFIGURATIONS.
EXAMPLE OF STANDARD STATEMENT-- WHILE PRINTSTATUS = BUSY DO,
EXAMPLE OF CAMAC STATEMENT-- WHILE CRTSTATUS = BUSY DO.

CLASS- - - - .501 (CATY)
AUTHOR(S)- - F R GOLDING , DARESBURY LABORATORIES
NAME- - - - CATY
COMPUTER- - ANY
SOFTWARE TYPE - - LANGUAGE

DESCRIPTION- -
CATY IS A MACHINE INDEPENDENT HIGH-LEVEL LANGUAGE BASED UPON A SUBSET OF BASIC WITH EXTENSIONS FOR ADDRESSING CAMAC. PROGRAMS WRITTEN IN CATY ARE COMPILED AND NOT INTERPRETED. THUS, THE SPEED OF OPERATION WHEN CAMAC IS TESTED UNDER CATY IS COMPARABLE WITH THE SPEED OF OPERATION IN APPLICATIONS. CATY HAS BEEN IMPLEMENTED ON PDP-11 (SEE .543).

.51 User-Oriented Programs I (full system support)

CLASS- - - -.51
TITLE- - -BACKGROUND-FOREGROUND SYSTEM FOR PULSE-HEIGHT ANALYSIS OF TWO-DIMENSIONAL MULTIWIRE PROPORTIONAL CHAMBER DATA
AUTHOR(S)- - DR. A. HEUSLER, IPK, KFA, JUELICH
ACRONYM- - -BFG
AVAILABLE - - - - ON PAPER TAPE, ASCII CODE
OPERATIVE DATE- - 1974?
COMPUTER- - PDP-15, CORE REQUIREMENTS-- 24K
INTERFACE- BORER TYPE 2200
MIN SYSTEM CONFIGUR.- DISK, MAGTAPE, DECTAPE
MEMORY SCANNING DISPLAY (IN-HOUSE)
SOFTWARE TYPE - - SYSTEM PROGRAM
LANGUAGE(S)-- FORTRAN & MACRO ASSEMBLER

DESCRIPTION--
THE SYSTEM SOFTWARE PERMITS START AND STOP OF BLOCK TRANSFER FROM THE A/D CONVERTERS TO THE PDP-15 MEMORY (LIST MODE OUTPUT ONTO MAGTAPE ON-LINE SORTING IF DESIRED).
THE BORER INTERFACE HAS BEEN MODIFIED TO ALLOW BLOCK LENGTHS UP TO 4K 18 BIT WORDS.

CLASS- - - - .51
TITLE- - - - CAMAC OPERATING SYSTEM FOR CONTROL APPLICATIONS
AUTHOR(S)- - DR. B. MERTENS, IKP, KFA, JUELICH
PUBL REF- CAMAC BULLETIN NO 9, MARCH 1974
ACRONYM- - - COS
AVAILABLE IN FORM - ON PAPER TAPE, ASCII CODE
OPERATIVE DATE- - 1972
COMPUTER- - PDP-15, CORE REQUIREMENTS -- 16K
INTERFACE- BORER TYPE 2200
SOFTWARE TYPE - - SYSTEM PROGRAM
LANGUAGE(S)- - - FORTRAN & MACRO ASSEMBLER
CAMAC FACILITIES- SYMBOLIC DEVICE NAMES USED,
SINGLE & MULTIPLE ACTION PER INSTRUCTION,
REAL-TIME DEMAND HANDLING INCORPORATED.

DESCRIPTION--
THE SYSTEM SOFTWARE PACKAGE PERMITS READ AND WRITE OF UP TO 100 MODULES, REAL-TIME TASKS MAY BE DEFINED ON-LINE, ABOUT 60 ELEMENTARY COMMANDS ARE PREDEFINED,SUCH AS--
-NAME MODULE/C=1, N=2, A=3/DEFINE SYMBOLIC NAME
-READ MODULE/F=0
-WRITE MODULE 321/F=16
-DISAB MODULE/F=24
-DEFINE TASK/OPEN A TASK-DEFINITION
-END/CLOSE TASK-FILE
-AFTER 15 SECS TASK/EXECUTE USER-DEFINED TASK
-15 SECS FROM NOW
-SOLL MODULE 3456/VALUE TO BE WRITTEN NEXT TO MODULE

CLASS- - - - .51
TITLE- - - - TRIUMF CONTROL SYSTEM SOFTWARE
AUTHOR(S)- - D. P. GURD, W. K. DAWSON,
TRIUMF, UNIVERSITY OF ALBERTA, CANADA
PUBL REF- CAMAC BULLETIN NO 5, NOVEMBER 1972
OPERATIVE DATE- - 1973
COMPUTER- - 4 SUPERNOVAS
INTERFACE- IN-HOUSE TYPE
SOFTWARE TYPE - - FULL SYSTEM SUPPORT FOR
CONTROL OF TRIUMF CYCLOTRON

DESCRIPTION--
THE SYSTEM SOFTWARE PACKAGE MONITORS OVER 1000 ANALOGUE PARAMETERS AND 1000 DIGITAL STATUS POINTS, SEARCHES OUT-OF-LIMIT READINGS, DISPLAYS MEASUREMENTS ON REQUEST,
SETS OVER 300 ANALOGUE POINTS FROM A CENTRAL CONSOLE AND PERFORMS A NUMBER OF OTHER ROUTINES.
A REAL-TIME EXECUTIVE PROGRAM - NATS (FOR NOVA ASYNCHRONOUS TASKING SUPERVISOR) - SCHEDULES AND SUPERVISES CAMAC TASKS, SUPPORTED BY A SUBPROGRAM LIBRARY, AS THEY ARE REQUESTED.
JOBS TO BE PERFORMED ARE STRUCTURED INTO SEQUENCES OF CAMAC OPERATIONS SPECIFIC TO A PIECE OF HARDWARE (= CAMAC MODULE).
THERE IS THUS A DIRECT MODULAR HARDWARE-SOFTWARE CORRESPONDENCE. CONTROL IS BASICALLY CLOCK-INITIATED SOFTWARE SCAN OF CYCLOTRON MONITORING, BUT INTERRUPTS ARE INCLUDED, MAINLY INITIATED BY CONSOLE.

CLASS- - - - .51
AUTHOR(S)- D GURD, TRIUMF, UNIV OF ALBERTA, CANADA
NAME- - - - CAMAC
OPERATIVE DATE- - 1973
SOFTWARE TYPE - - SYSTEM SOFTWARE

DESCRIPTION- -
THE SYSTEM SOFTWARE- CAMAC - CONSISTS OF SEVERAL SUBROUTINE CALLS. THESE ARE- -
PRIMITIVE SUBROUTINES PERFORMING THE ACTUAL I/O OPERATIONS, MODULE SUBROUTINES, THE MUX/ADC SUBROUTINES, CAMAC LAMS OR INTERRUPTS, SERIAL TASKS, AND AN INTERPRETER (FOR DATA).

.53 User-Oriented Programs III (subprograms, etc.)

CLASS- - - - .53(BASIC)
TITLE-- CAMAC AND INTERACTING PROGRAMMING
AUTHOR-- DR E M RIMMER, CERN, GENEVA
PUBL. REF.-- PROC CAMAC SYMPOS, LUXEMBG, DEC 1973,
& BASIC CALLABLE ROUTINES, NP GROUP NOTE, NP-DHG
ACRONYMS - - HPCMA, HPCMB, HPCMC
PRG MAINTENANCE BY - DR E M RIMMER
OBTAINABLE FROM- - NP-DIV, CERN, CH-1211 GENEVA
AVAILABLE IN FORM - PAPER TAPE, ASCII CODE
OPERATIVE DATE- - 1971/72
COMPUTER- - H-P 2100-SERIES, 8K OF 16 BIT WORDS
INTERFACES - BORER 2201, CERN 7218 & HPCC-066
MIN SYSTEM - - TTY OR TEK 4010 TERMINAL & CC A1
SOFTWARE TYPE - - SET OF SUBROUTINES
LANGUAGE - - HP ASSEMBLY
HOST LANGUAGE- - - BASIC (HP EXTENSION OF)
CAMAC FACILITIES- IN-LINE CODED CALLS IN BASIC, SUBROUTINES IN ASSEMBLY, ABSOLUTE ADDRESS
FACILITIES - SINGLE & MULTIPLE ACTION PER INSTRUCTION, NO DEMAND HANDLING

DESCRIPTION- -
THESE BASIC-CALLABLE CAMAC SUBROUTINES IN THREE VERSIONS FOR THREE INTERFACES PROVIDE MOST COMMAND FACILITIES FOR CONTROL AND DATA TRANSFER. DATA WORDS MAY BE 16 OR 24 BITS LONG (ONLY 16 BITS FOR HPCC-066), BINARY, BCD OR LOGIC (0 OR 1).
ROUTINES COVER BLOCK TRANSFERS, PROGRAMMED AND SEQUENTIAL ADDRESSING & UTILITY ROUTINES, IN TOTAL 18 & 3 OPTIONALLY.
GENERAL FORM OF CALL STATEMENT--
- - -CALL (SUBROUTINE NUMBER,C,N,A,F,D,Q)
- - -CALL (SUBROUTINE NUMBER,C,N,A,F,D(I),Q,W)
WHERE W IS WORD COUNT, D IS DATA, C,N,A,F, & Q HAVE USUAL MEANING
EX-- CALL(10,1,2,0,16,D(I),Q,20)
TIME IS APPR 5 MSECS/STATEMENT, BLOCK TRANSFER CALL GENERATED DIRECTLY BY INTERFACE ARE MUCH FASTER.

CLASS- - - - .53
TITLE- - - - CAMAC FUNCTION FOR RT11
AUTHOR(S)- - L BYARS, R KEYSER
NAME- - - - CAMAC
VERSION- - - RT11
PRG MAINTENANCE BY - ORTEC
OBTAINABLE FROM- - ORTEC
AVAILABLE ON PAPER TAPE
OPERATIVE DATE- - 1974
COMPUTER- - PDP-11
INTERFACE- DC011 (EG&G/ORTEC)
SOFTWARE TYPE - SUBROUTINES
LANGUAGE- PDP-11 ASSEMBLY
HOST LANGUAGE- - - RT11/FORTRAN
INCORP TECHNIQUE.- EMBEDDED CAMAC FEATURES
CAMAC FACILITIES- SINGLE OR MULTIPLE INSTRUCTIONS, DEMAND HANDLING

DESCRIPTION- -
THIS SOFTWARE PACKAGE CONSISTS OF A NUMBER OF SUBROUTINES FOR FORTRAN/RT11 CALLING CAMAC FUNCTIONS.
THE CAMAC CALL STATEMENT HAS THE FOLLOWING FORM--
CALL CAMAC (IF, IN, IA, IQ, IDATA)
THEY ARE USED TO TRANSFER DATA TO/FROM CAMAC AND FOR TEST PURPOSES.
IF, IN, IA ARE RESPECTIVELY FUNCTION, STATION ADDRESS AND SUBADDRESS, IQ IS BOTH QBIT AND XBIT.

CLASS- - - - .53(FORTRAN)
TITLE- - - - SPECIFICATIONS FOR STANDARD CAMAC SUBROUTINES
AUTHOR(S)- - RICHARD F THOMAS JR.
PUBL REF- - CAMAC BULLETIN NO 6, MARCH 1973
ACRONYMS - - SEE DESCRIPTION
OBTAINABLE FROM- - USAEC NIM COMMITTEE, CAMAC SWG
AVAILABLE IN FORM - ALGORITHM
OPERATIVE DATE- - 1973
COMPUTER- - INDEPENDENT,MEMORY SIZE NOT SPEC.
INTERFACE- ANY
SOFTWARE TYPE - - SET OF SUBROUTINES
LANGUAGE - - FORTRAN
CAMAC FACILITIES- FUNDAMENTAL CAMAC OPERATIONS, STANDARD BLOCK TRANSFERS IN SINGLE AND MULTIPLE ACTION STATEMENTS

DESCRIPTION- -
A SET OF 6 SUBROUTINES, OF WHICH ONE IS CALLED BY ALL THE OTHER PERMITS A GREAT VARIETY OF SINGLE AND MULTIPLE CAMAC OPERATIONS TO BE PERFORMED. DEMAND HANDLING, OTHER THAN BY TEST LAM, IS NOT COVERED.
THE SUBROUTINES EXECUTE CAMAC OPERATIONS AS FOLLOWS--
CMCBSC - SINGLE CAMAC FUNCTION AT SINGLE ADDRESS
ONE OR MORE TIMES
CMCSEQ - SINGLE CAMAC FUNCTION AT SUCCESSION OF ADDRESSES
CMCASC - SPECIFIED CAMAC FUNCTION IN ADDRESS SCAN MODE
CMCRPT - SPECIFIED CAMAC FUNCTION IN REPEAT MODE
CMCSTP - SPECIFIED CAMAC FUNCTION IN STOP MODE
CMCLUP - SPECIFIED CAMAC FUNCTION AT A HIERARCHICAL SEQUENCE OF ADDRESSES WITH OPTIONAL SKIP OF SEQUENCE BASED ON Q.
GENERAL FORM OF STATEMENT--
CALL CMC... (PARAMETER LIST)
EXAMPLE--
CALL CMCSTP (F,B,C,N,AD,LN,DATA,ERRORA,NEX)

CLASS- - - - .53(FORTRAN)
TITLE- - - - FORTRAN SUBROUTINES
AUTHOR(S)- - H POHL
NAME- - - - FORTRAN CALLS
VERSION- - - V002
OBTAINABLE FROM- - H POHL, ZEL, KFA, JUELICH
AVAILABLE ON DEC-TAPE
OPERATIVE DATE- - MARCH 1973
COMPUTER- - PDP-11, 16K OF 16 BITS
INTERFACE- BORER TYPE 1533A
SOFTWARE TYPE - - PROCEDURE CALLS
INCORP TECHNIQUE.- IN-LINE SUBROUTINE CALLS
LANGUAGE - - FORTRAN ON PDP-11 (THREADED CODE)
CAMAC FACILITIES- SINGLE ACTION STATEMENTS

DESCRIPTION- -
FORTRAN SUBROUTINES FOR SINGLE ACTIONS. MUCH SIMPLER THAN THE NIM APPROACH (REF. R. F. THOMAS) FOR THE BORER 1533A CONTROLLER WRITTEN IN RE-ENTRANT CODE.

CLASS- - - - .53 (FORTRAN)
AUTHOR(S)- - J M STEPHENSON, L A KLAISNER
ACRONYM- - - KSCLIB
OBTAINABLE FROM- - KINETIC SYSTEMS CORP
OPERATIVE DATE- - 1974
COMPUTER- - PDP-11
INTERFACES - TYPES 3911A, 3991 & 3992 (KINETIC)
CORE REQUIREMENTS- 16K
LANGUAGE - - FORTRANN
SOFTWARE TYPE - LIBRARY OF FORTRAN FUNCTIONS AND SUBROUTINES

DESCRIPTION- -
THIS SOFTWARE PACKAGE IMPLEMENTS THE CMCBSC SERIES OF STAND-ARD FORTRAN CALLS DESCRIBED IN CAMAC BULLETIN NO 6, 1973. IT ALSO INCLUDES THE BIT MANIPULATION FUNCTIONS EXCLUSIVE OR, INCLUSIVE OR, AND, NOT, & SHIFT. THE PACKAGE SUPPORTS UP TO 8 CRATES INTERFACED THROUGH MODEL 3911A UNIBUS @) CRATE CONTROLLERS, UP TO 7 CRATES PER 3991 BRANCH DRIVER AND UP TO 61 CRATES PER 3992 SERIAL BRANCH DRIVER. THE NUMBER OF PARALLEL AND SERIAL BRANCHES SHOULD BE LESS THAN 8.
@) UNIBUS IS A TRADE MARK OF DIGITAL EQUIPMENT CORP.

CLASS- - - - .53
TITLE- - - - I/O MACROS FOR CAMAC
AUTHOR(S)- - D STUCKENBROCK, G KLENERT, SIEMENS AG KARLSRUHE
ACRONYM- - - MACAM
OBTAINABLE FROM- - SIEMENS AG, D-75 KARLSRUHE 21 RHEINBRUCKENSTR 50, ABT E 612
AVAILABLE ON PAPER TAPE, CARDS AND SOURCE DECK
OPERATIVE DATE- - NOVEMBER 1974
COMPUTER- - PR 320/330
INTERFACE - CC 320, SC 330
CORE REQUIREMENTS- 1K X 16 BITS (EXCL SUPERVISOR)
MIN SYSTEM CONFIGUR.- TTY, SUPERVISOR PROGRAM
SOFTWARE TYPE - - I/O ROUTINES
CAMAC SOFTWARE ENVIRONMENTS- ASSEMBLER 300
LANGUAGES - MAKROS IN ASSEMBLER, CALLS IN FORTRAN
FACILITIES - CONCURRENT OPERATION BY SEVERAL USERS
SYSTEM RUNS UNDER REAL-TIME SUPERVISOR (EXECUTIVE)

DESCRIPTION- -
A SET OF I/O MACRO SUBROUTINES CAN BE CALLED BY ANY USER PROGRAM CONCURRENTLY RUNNING ON THE COMPUTER, PROVIDED THEY OPERATE UNDER A REAL-TIME SUPERVISOR PROGRAM. THE ROUTINES COMPRISE THE FUNCTIONS READ, WRITE, AND EXECUTION OF CONTROL COMMANDS. BLOCK TRANSFERS ARE PERFORMED ON CONSTANT OR VARIABLE CAMAC ADDRESS, AND IN INCREMENT MODE OR RANDOM-LIST MODE. THE COORDINATION OF USER PROGRAMS AND CAMAC PROVIDED BY THE SUPERVISOR, FACILITATES GREATLY THE LAM HANDLING. THE SYSTEM ALLOWS UP TO 32 CONCURRENTLY OPERATING USER PROGRAMS AND UP TO 8 BRANCHES WITH - IN ALL - 24 CRATES. SYSTEM SOFTWARE ENVIRONMENTS FACILITATE INCORPORATION OF THE SUBROUTINE CALLS AS STATEMENTS EMBEDDED IN FORTRAN PROGRAMS.

.54 Support Software I (translators)

CLASS- - - - .54
TITLE- - - S/UNIP AN UNIVERSAL MACRO PROCESSOR
AUTHOR(S)- - SOFTWARE-PARTNER
PRG MAINTENANCE BY - SOFTWARE-PARTNERS
OBTAINABLE FROM- - - SOFTWARE-PARTNERS, 61 DARMSTADT, GROSSGERAUERWEG 2 GERMANY
OPERATIVE DATE- - APRIL 1974
SOFTWARE TYPE - - MACRO PROCESSOR
LANGUAGE - - WRITTEN IN HIGH LEVEL LANGUAGE
COMPUTER- - CAN RUN ON IBM, UNIVAC, CDC, ICL, SIEMENS ETC.
CAMAC FACILITIES- INCORPORATED IN-LINE FOR FULL-SET IML WITH MACRO PROCESSOR DIRECTIVES

DESCRIPTION- -
S/UNIP IS A LANGUAGE INDEPENDENT MACRO PROCESSOR AND THEREFORE A TOOL FOR MACRO EXPANSION OF EVERY EXISTING OR OR FUTURE PROGRAMMING LANGUAGE. THUS S/UNIP MAINTAINS AND PROCESSES MACROS IN HIGH LEVEL LANGUAGES (FORTRAN, BASIC, ALGOL, PEARL, ETC.) AS WELL AS ASSEMBLY LANGUAGES. S/UNIP OPERATES AS A PRE-PROCESSOR GENERATING SOURCE CODE STATEMENTS FOR SUBSEQUENT COMPILATION, POSSIBLY ON ANOTHER COMPUTER.

CLASS- - - - .541
TITLE- - - - MACROS FOR 1533A
AUTHOR(S)- - MR. HEER
NAME- - - - MACRO 1533A
PRG MAINTENANCE BY - MR. HEER
OBTAINABLE FROM- - -MR. HEER, ZEL, KFA, JUELICH
AVAILABLE ON DEC-TAPE
OPERATIVE DATE- - FEBRUARY 1973
COMPUTER- - PDP-11, MIN 8K 16 BIT WORDS
INTERFACE - - - - BORER TYPE 1533A
MIN SYSTEM CONFIGUR.- DOS V004, 008, 009
SOFTWARE TYPE - - MACRO-SET
LANGUAGE - - MACRO 11
CAMAC FEATURE INCORPORATED IN-LINE
CAMAC SOFTWARE ENVIRONMENTS-ASSEMBLER
CAMAC FACILITIES- SINGLE ACTION STATEMENTS, SYMBOLIC DEVICE NAMES

DESCRIPTION- -
THIS IS A SIMPLE MACRO SET (NO DECLARATIONS) FOR SINGLE ACTION STATEMENTS. EXECUTION SPEED IS HIGHER (APPROX 30 MICROSECS PER INSTRUCTION, DEPENDING ON TYPE OF INSTRUCTION ON TYPE OF PDP-11). NOT INTERRUPTABLE MACROS (PRIORITY=7)

CLASS- - - - .543
TITLE- - - - A BASIC-MACRO 11 COMPILER
AUTHOR(S)- - B. BECKS
PUBL REF - - CAMAC BULLETIN NO 10, JULY 1974
ACRONYM- - - MABA
PRG MAINTENANCE BY B BECKS
OBTAINABLE FROM- - B BECKS, ZEL, KFA, JUELICH
AVAILABLE ON DEC-TAPE
OPERATIVE DATE- - JANUARY 1974
COMPUTER- - PDP-11, MIN 16K OF 16 BIT WORDS
INTERFACE- BORER TYPE 1533A
MIN SYSTEM CONFIGUR.- DOS V08 OR V09 16K
SOFTWARE TYPE - - COMPILER
LANGUAGE - - BASIC
INCORP TECHNIQUE.- IN-LINE
CAMAC SOFTWARE ENVIRONMENTS- MACRO ASSEMBLER
CAMAC FACILITIES- SINGLE ACTION STATEMENTS

DESCRIPTION- -
THIS COMPILER TRANSLATES TESTED (INTERPRETIVE) BASIC PROGRAMS INTO MACRO-11 SOURCE CODE. RUN-TIME IS IMPROVED BY A FACTOR OF 15 TO 20. EASILY ADAPTABLE TO OTHER CONTROLLERS (MACROS).
OUTPUT CODE LINKED WITH FLOATING POINT PACKAGE CAN RUN ON STAND-ALONE MINI-COMPUTERS.

CLASS- - - - .543(CATY)
TITLE- - - - A CAMAC TESTING AID FOR USE ON PDP-11
AUTHOR(S)- - F R GOLDING , DARESBURY LABORATORIES
NAME- - - - CAT11
OBTAINABLE FROM- - APPLIED COMPUTER SYSTEMS LTD, 2 CHORLTON ST, MANCHESTER M1 3JL, UK, GEC-ELLIOTT, NUCLEAR ENTERPRISES, AND WENZEL ELEKTRONIK
OPERATIVE DATE- - 1973
COMPUTER- - PDP-11
INTERFACES - - - GEC-ELLIOTT EXECUTIVE SUIT, WENZEL TYPE C-CSC-11, N.E. TYPE 9030SYSTEM
CORE REQUIREMENTS- 4K OR 8K ACCORDING TO VERSION
MIN SYSTEM CONFIGUR.- CONTROL VISTA, READER, PUNCH
SOFTWARE TYPE - - SYSYEM (EXECUTIVE, COMPILER ETC)
LANGUAGE - - CATY (BASED ON BASIC)

DESCRIPTION- -
USERS TEST PROGRAMS ARE TYPED IN AND THEREAFTER COMPILED AND RUN. IT IS POSSIBLE TO EDIT THE PROGRAM AND RERUN IT WITH-OUT HAVING TO RETYPE THE ORIGINAL PROGRAM. CAMAC COMMANDS ARE EMBEDDED IN PROGRAM AS STATEMENT LINES.
CAT11 HAS INTERRUPT AS SYSTEM FEATURE, THE USER MAY TYPE HIS OWN INTERRUPT ROUTINE.
THE CAT11 EXECUTIVE PROGRAM CHANGES SLIGHTLY WITH INTERFACE USED, BUT ALL ROUTINES ARE IDENTICAL.

CLASS- - - - .544(BASIC)
TITLE- - - - A PDP-11 BASIC EXTENSION FOR CAMAC PROGRAMMING
AUTHOR(S)- - I BALS, E DE AGOSTINO CNEN, ROME
PUBL REF - - - CAMAC BULLETIN NO 7, JULY 1973
OPERATIVE DATE- - 1973
COMPUTER- - PDP-11
INTERFACE - - EXECUTIVE SUITE (GEC-ELLIOTT)
SOFTWARE TYPE - - INTERPRETER
INCORP TECHNIQUE.- SUBROUTINES IN ASSEMBLY CODE
CAMAC SOFTWARE ENVIRONMENTS- BASIC
LANGUAGE - - BASIC (EXTENDED)

DESCRIPTION- -
THE SURROUTINES WHICH EXTEND THE BASIC INTERPRETER TO CAMAC ARE CALLED BY AN EXTERNAL FUNCTION STATEMENT, WHERE ADDRESS, FUNCTION, ETC, ARE TRANSMITTED AS ARGUMENTS. THE STATEMENT HAS THE FOLLOWING GENERAL FORM- -
LET U = EXF (A1,A2, ... ,A10)
THE FIRST ARGUMENT SELECTS THE APPROPRIATE SUBROUTINE. DATALESS, READ, AND WRITE OPERATIONS WITH DIRECT/INDIRECT ADDRESSING ARE POSSIBLE. ALSO SINGLE OR BLOCK TRANSFERS IN ADDRESS SCAN, REPEAT OR STOP MODES CAN BE PERFORMED.
THE EXTENSION FEATURES LAM HANDLING.

CLASS- - - - .544(BASIC)
TITLE- - - - A CAMAC EXTENDED BASIC LANGUAGE
AUTHOR(S)- - J M SERVENT (SCHLUMBERGER), FRANCE
PUBL. REF.-- PROC CAMAC SYMPOS, LUXEMBG, DEC 1973
ACRONYM- - - CASIC
OBTAINABLE FROM- - SCHLUMBERGER,BAGNEUX, FRANCE
OPERATIVE DATE- - 1973
COMPUTER- - PDP-11
INTERFACES - - - I CP 11 AND J CC 11
SOFTWARE TYPE - - INTERPRETIVE LANGUAGE EXTENDED WITH MACRO-INSTRUCTION GENERATOR
LANGUAGE - - - - BASIC (EXTENDED)
INCORP TECHNIQUE - IN-LINE CAMAC STATEMENTS

DESCRIPTION- -
STANDARD BASIC IS EXTENDED WITH 4 NEW TYPES OF STATEMEMENTS AND 2 SPECIAL REGISTERS. EXECUTION OF CAMAC STATEMENTS ARE SPEEDED UP ABOUT 10 TIMES COMPARED WITH STANDARD BASIC.
TYPICAL STATEMENTS--
- -DECLARATIVE-- 100 LET $S8 = STA (2,4,N+3,A+2)
- -OPERATIONAL-- 130 R1 = CAM ($S8, READ)
- -CONDITIONAL-- 156 IF %QCAM = 0 THEN LET A = A+1
- -INTERRUPT/LAM-- 23 ON LAM %REG THEN GOTO 130
THE INTERRUPT WILL BE SERVICED ONLY WHEN PROGRAM HAS ADVANCED TO THE LAM-HANDLING STATEMENT.

CLASS- - - - .544(FOCAL)
TITLE- - - - FOCAL OVERLAY FOR CAMAC DATA AND COMMAND HANDLING
AUTHOR(S)- - F MAY, H HALLING, K PETRECZEK
PUBL REF- - CAMAC BULLETIN NO 1, JUNE 1971
ACRONYM- - - FOCADAT
OPERATIVE DATE- - 1970
COMPUTER- - PDP-8, 4K OR 8K 12 BIT WORDS
INTERFACE- - IN-HOUSE CC & INTERFACE
SOFTWARE TYPE - - INTERPRETER (EXTENDED)
INCORP TECHNIQUE - - CAMAC EXTENSION ON OVERLAY, IN-LINE CODING OF CAMAC COMMANDS
CAMAC SOFTWARE ENVIRONMENTS- FOCAL

DESCRIPTION- -
THE INTERPRETER IS PRIMARILY INTENDED FOR EASILY PROGRAMMED ON-LINE CAMAC SYSTEMS IN NON-TIME-CRITICAL CONTROL AND DATA HANDLING APPLICATIONS AND FOR TEST ROUTINES.
THERE ARE 9 CAMAC STATEMENT TYPES COVERING GENERAL CONTROLS (Z, C, I) AND CAMAC COMMANDS WITH/WITHOUT DATA TRANSFER.
THE GENERAL FORM OF A CAMAC STATEMENT IS --
+A CF,C,N,A,F,FB,HW [,LW,Q]
WHERE SEVERAL PARAMETERS MAY BE OMITTED.

CLASS- - - - .544(BASIC)
TITLE- - - - 8-USER BASIC UNDER DOS WITH INTERPRETER EXTENDED FOR CAMAC
AUTHOR(S)- - PFEIFFER, SPICKMANN, CARLEBACH
VERSION- - - 001
PRG MAINTENANCE BY - D P PFEIFFER
OBTAINABLE FROM- D P PFEIFFER, ZAM, KFA, JUELICH
AVAILABLE ON DEC-TAPE
OPERATIVE DATE- - JANUARY 1974
COMPUTER- - PDP-11, 16K OF 16 BIT WORDS
INTERFACE- - BORER TYPE 1533A
MIN SYSTEM CONFIGUR.- DOS V08 OR V09, 16K
SOFTWARE TYPE - -DOS SYSTEM INTERFACE TO CAMAC
LANGUAGE - - BASIC
INCORP TECHNIQUE.- EXTENSION OF INTERPRETER

DESCRIPTION- -
THE 8-USER BASIC CAN BE RUN UNDER DOS. A HELP FILE CONTAINS ALL MODIFICATIONS OF THE 1 TO 8 USER BASIC. NO INTERRUPT HANDLING. COMMUNICATION BETWEEN THE 8 USERS IS POSSIBLE BY ONE COMMUNICATION WORD PER USER. EXPANDED ERROR MESSAGE HANDLING. FILE HANDLING EXTENDED. TIME-COMMAND ADDED.

CLASS- - - - .544
TITLE- - - - ORACL (TM), AN INTERPRETIVE REAL-TIME MONITOR WITH CAMAC SUPPORT
AUTHOR(S)- - L BYARS, R KEYSER, (ORTEC INC.)
ACRONYM- - - ORACL (TM)
PRG MAINTENANCE BY - ORTEC
OBTAINABLE FROM- - - ORTEC
AVAILABLE IN FORM - PAPER TAPE AND ON DISK
OPERATIVE DATE- - APRIL 1974
COMPUTER- - PDP-11
INTERFACE- EG&G/ORTEC TYPE DC011
CORE REQUIREMENTS- MIN 5K OF 16 BIT WORDS
MIN SYSTEM CONFIGUR.- TTY & DC011
SOFTWARE TYPE - - INTERPRETER, SYSTEM MONITOR
LANGUAGE - - PDP-11 ASSEMBLER
INCORP TECHNIQUE.- CAMAC FEATURES ARE EMBEDDED
CAMAC FACILITIES- SINGLE OR MULTIPLE INSTRUCTIONS, DEMAND HANDLING INCL.

DESCRIPTION- -
ORACL INTERPRETS ARITHMETIC STATEMENTS, PROGRAM CONTROL STATEMENTS, COMMENTS, I/O STATEMENTS, AND HARDWARE CONTROL STATEMENTS AND EXECUTES THE DESIRED FUNCTION.

ORACL (TM) IS A TRADE MARK REGISTERED BY ORTEC, INC.

.55 Support Software II

CLASS= = = = .553(FOCAL/PAL)
TITLE= = = = A FOCAL INTERRUPT HANDLER FOR CAMAC
AUTHOR(S)= = F MAY, W MARSCHIK, H HALLING
PUBL REF= CAMAC BULLETIN NO 6, MARCH 1973
ACRONYM= = = FOCALINT
OPERATIVE DATE= = 1971
COMPUTER= = PDP=8
SOFTWARE TYPE = = INTERRUPT HANDLER (SYSTEM PRUGR)

DESCRIPTION= =
FOCALINT IS A GENERAL PURPOSE SYSTEM PROGRAM, ADAPTABLE FOR SPECIAL USE. UP TO 3 CRATES WITH 24 INTERRUPTS EACH CAN BE SERVICED. ONE PROGRAM LINE IN FOCAL IS RESERVED FOR EACH INTERRUPT. SHORT ROUTINES CAN BE TYPED INTO THESE LINES SERVICING THE ASSOCIATED INTERRUPTS, ALTERNATIVELY A FOCAL SUBROUTINE CAN BE USED. CURRENT LINE IN THE BACKGROUND PROGRAM WILL BE FINISHED BEFORE JUMPING TO INTERRUPT ROUTINE AND RETURNS TO NEXT LINE IN THE BACKGROUND PROGRAM AFTER SERVICING.

.57 Test Routines

CLASS= = = = .573
TITLE= = = = CAMAC TEST PROGRAM
AUTHOR(S)= = DR. B MERTENS, IKP, KFA, JUELICH
AVAILABLE ON PAPER TAPE, ASCII CODE
OPERATIVE DATE= = 1971
COMPUTER= = PDP=11, 16K OF 16 BIT WORDS
INTERFACE= = BORER TYPE 2200
SOFTWARE TYPE = = TEST ROUTINES, STAND=ALONE PRGS

DESCRIPTION= =
STAND ALONE PROGRAMS TEST SOME FUNCTIONS OF THE BORER TYPE 2200 INTERFACE, THE CRATE CONTROLLER AND TWO IN=HOUSE MODULES (C01 & C02).
ERROR MESSAGES ARE OUTPUT IF THERE ARE HARDWARE FAILURES.

CLASS= = = = .573
TITLE= = = = 3911A TEST CAMAC
AUTHOR(S)= = L A KLAISNER
OBTAINABLE FROM= = KINETIC SYSTEMS CORP
OPERATIVE DATE= = 1973
COMPUTER= = PDP=11
INTERFACE = KINETICS TYPE 3911A
CORE REQUIREMENTS= 4K
SOFTWARE TYPE = = TEST ROUTINE

DESCRIPTION= =
A STAND ALONE PROGRAM FOR EXERCISING A CAMAC SYSTEM FROM A TELETYPE. IT SUPPORTS UP TO 8 CRATES WITH MODEL 3911A UNIBUS @) CRATE CONTROLLERS. A FUNCTION MAY BE EXECUTED ONCE OR REPETITIVELY.

@) UNIBUS IS A TRADE MARK OF DIGITAL EQUIPMENT CORP.

CLASS= = = = .573
TITLE= = = = TEST CAMAC
OBTAINABLE FROM= = KINETIC SYSTEMS CORP
OPERATIVE DATE= = 1972
COMPUTER= = PDP=11
INTERFACE = KINETICS TYPE KS0011
CORE REQUIREMENTS= 4K
SOFTWARE TYPE = = TEST ROUTINE

DESCRIPTION= =
A STAND ALONE PROGRAM FOR EXERCISING A CAMAC SYSTEM FROM A TELETYPE. IT SUPPORTS ONE BRANCH DRIVER WITH UP TO 7 CRATES. A FUNCTION MAY BE EXECUTED ONCE OR REPETITIVELY.

CLASS= = = = .573
TITLE= = = = PDP=11 INTERFACE TEST PROGRAMME
OBTAINABLE FROM= = GEC=ELLIOTT
OPERATIVE DATE= = 1974
COMPUTER= = PDP=11
INTERFACE= GEC=ELLIOTT EXECUTIVE SUITE FOR PDP=11
SOFTWARE TYPE = = TEST ROUTINE
LANGUAGE = = PAL=11 ASSEMBLER

DESCRIPTION= =
THIS IS A STAND=ALONE PROGRAM USED IN CHECKING THE EXECUTIVE SUITE, A MODULAR PDP=11 = CAMAC INTERFACE. DIAGNOSTIC MESSAGES ARE ISSUED.

ACTIVITIES OF THE CAMAC WORKING GROUPS

The ESONE Committee in Europe and the U.S.AEC NIM Committee in America have both authorised different working groups to investigate specific aspects of CAMAC. The European and American working parties are performing their activities in close collaboration.

ESONE-CAMAC WORKING GROUPS

Dataway Working Group

Chairman: R. Patzelt, TH Wien

The first meeting of a Serial System Compatibility Sub-Group was held at KFA Jülich on 20/21 June 1974 under the chairmanship of D.L. Abbott of KFA.

The motivations for this sub-group are two-fold:

(a) an interest in providing an extremely simple serial-by-byte driven system for instruments or terminals connected directly into the Serial Highway loop.

(b) to identify and describe those fundamental characteristics of the Serial Highway that are independent of the type of device connected to it so that other serial transmission systems arising in other application areas (process control, air traffic, etc.), might be compatible with CAMAC.

Some very promising ideas on these topics are now the subject of further investigation by the sub-group members.

Alan Lewis acted as an observer for the ESONE Dataway Working Group at the NIM-CAMAC meetings at which the Serial Highway description was clarified and the topic of compatibility discussed.

Software Working Group

Chairman: I.N. Hooton, AERE Harwell

Continuous collaboration between the NIM and ESONE Software Working Groups, including cross representation at recent meetings, has resulted in final agreement on the document "The Definition of IML (A Language for Use in CAMAC Systems)". Approval for publication has been given by both the NIM and ESONE Committees. References to existing implementations appropriate to specific computers and host languages are included.

The document is directed to implementors and users of CAMAC systems and will be published as soon as possible so that additional experience may be gained. It will also serve as the basis for a formal specification which will have the same technical content except where changes are needed to correct errors or omissions.

The ESONE Software Working Group will continue its work on IML, both in preparing the specification and in considering the interfaces between IML, the hardware, and host languages.

The work on BASIC as a vehicle for module testing needs to be reinforced and anyone with an interest in this activity is invited to contact the Working Group.

Analogue Signals Working Group

Chairman: T. Friese, HMI Berlin

During the meeting at Marburg University on 8/9th July, 1974 the topic was discussed of standardising CAMAC voltage and current signals appropriate to industrial applications for measurement and control. Standards already exist (Reference IEC Publication 381, DIN 19230 for current signals, 0-20 mA or 4-20 mA and IEC Publication 323, DIN 19232 and DINZ 44800 for voltage signals, 0 to +10 V or −10 V to +10 V) and it seemed expedient to incorporate these into three classes of signals. Class I for single-ended signals, Class II for floating signals with common mode voltage up to ±10 V and Class III with common mode voltage up to ±400 V. Proposals were made and discussed on the use of these classes and the protection to be provided against excessive voltage application to inputs and outputs, particularly 220 V a.c. Suitable signal connectors (e.g. Lemo 00250, 0303, 1303 and multipole connectors) were also discussed and the Mechanics Working Group will be requested to assist in reaching a recommendation.

Information Working Group

Chairman: H. Meyer, CBNM-JRC, EURATOM Geel, Belgium

The foundation of the European CAMAC Association (ECA) has encouraged the Working Group to reconsider in collaboration with non-ESONE ECA representatives additional possibilities for the promotion of CAMAC usage via information media. Examples of further activities that are envisaged are:

- Publication of suitable articles, announcements and news in periodicals that are oriented to specific application fields for which CAMAC will be useful.
- Foundation of a library of articles, CAMAC products and programs.
- Organisation of conferences and field oriented seminars.
- Participation in field oriented conferences to present and explain CAMAC.

NIM-CAMAC WORKING GROUPS

Dataway Working Group

Chairman: F.A. Kirsten, Lawrence Berkeley Laboratory

Software Working Group

Chairman: R.F. Thomas, Jr., Los Alamos Scientific Laboratory

The NIM Dataway and Software Working Groups (NDWG and NSWG) met July 15-19th 1974 at Los Alamos Scientific Laboratory in sun-basked New Mexico. Meetings of the Serial System Subgroup of the Dataway Working Group and of the Joint NDWG/NSWG Block Transfer Subgroup were held in conjunction with the working group meetings. Alan Lewis of Harwell represented ESONE at all of the meetings.

The principal items discussed were the Serial System Description and the proposed CAMAC Intermediate Language (IML). The Dataway Working Group sessions also included discussions regarding interfacing of CAMAC to other systems and clarification of the meaning of such terms as CAMAC Systems and CAMAC Compatibility. Also discussed were problems associated with digital and analogue grounding practice in the connecting of external equipment to CAMAC crates. In addition to the discussion regarding IML, the Software Working Group meeting was concerned also with Fortran CAMAC subroutines, the use of BASIC in CAMAC applications and the contents of a proposed software handbook.

Two operating CAMAC Serial Systems, constructed in accordance with the Serial System Description, were demonstrated by representatives of the Fermi National Accelerator Laboratory, the Los Alamos Scientific Laboratory, Jorway Corporation and Kinetic Systems Corporation.

NEWS

CAMAC FOR INDUSTRIAL PROCESSES

The Aluminum Company of America (ALCOA) has issued a second edition of Engineering Specifications for some functional instrumentation modules that are compatible with the CAMAC standard.

These specifications are intended to communicate to existing or potential suppliers some of the instrumentation requirements ALCOA has elaborated for its industrial control/computer applications. It is hoped that other users may be interested in the application of the specifications and in collaborating to elaborate further specifications for industrial CAMAC modules.

Copies of ALCOA Engineering Specifications for CAMAC may be obtained by writing to the following address:

Dale W. ZOBRIST
ALCOA Building
Pittsburgh, Pa 15219
USA

CAMAC SERIAL SYSTEMS GO

Although the joint NIM-ESONE document entitled CAMAC Serial System Organization (TID-26488, ESONE/SH/01) has only recently been issued, work on implementing Serial Highway components has been proceeding in several places. A remarkable demonstration of some of these components was held at the NIM Dataway and Software Working Group meetings, July 15-19, 1974 at the Los Alamos Scientific Laboratories, New Mexico. This demonstration was arranged through the joint efforts of members of Kinetics Systems Corporation, Jorway Corporation, Los Alamos Scientific Laboratories, and Fermi National Accelerator (formerly NAL).

Two systems were shown. In one of these, the length of the serial loop was 3000 miles ! A Kinetics Systems Type L-1 Serial Crate Controller was connected via a modem and telephone lines to a Serial Driver located at the Kinetic Systems offices in Lockport, Illinois, approximately 1500 miles from Los Alamos. Look-at-Me's generated in the crate at Los Alamos were interpreted by the Lockport Serial Driver and computer. The computer then transmitted commands which generated a multi-colour display on a TV monitor in Los Alamos. The serial highway was operated at 300 bits per second.

In contrast the other system was completely contained in one room, and the Serial Highway operated at 2.5 M bits per second. The components included a micro-programmed Branch Driver from the Los Alamos laboratories; a Branch Highway/Serial Highway interface from the Fermi laboratory and a Jorway SCC Type L-1. As was expected, these separately designed CAMAC components worked properly when connected together; the Los Alamos computer communicated through them to various modules in the crate. Jorway also demonstrated a programmable Serial Driver designed to exercise and test Serial Highways.

IDEAS AND TECHNIQUES

1

MNEMONICS FOR CAMAC FUNCTIONS

by

I. C. Pyle

Department of Computer Science, University of York, England

Received 11th March 1974

SUMMARY In CAMAC software it is convenient to use alphanumeric mnemonics to represent function codes. This paper reviews some existing sets of mnemonics for CAMAC functions and derives a new proposal.

Software for CAMAC includes means of specifying the CAMAC functions to be applied in the CAMAC actions. At the simplest level the F value is given numerically as a constant. In some cases it is required to be variable, but these cases are unusual. In most cases, a constant function is required, but a mnemonic alphanumeric string would be strongly preferred, avoiding the need for the user to write numerical function codes. Various sets of mnemonics for the CAMAC function codes have been introduced (see table). In some cases the sets are incomplete, in that no mnemonics are provided for non-standard or reserved functions.

Table of Mnemonics for CAMAC Functions

F( )	K	CAT11	TRUMPS	S & V	IML	(b)	(a)
0	RD1	RD1	RDCAM	LECGR1*	READ	CAMRD1	RD1
1	RD2	RD2	RDCAM2	LECGR2	READ2	CAMRD2	RD2
2	RZ1	RC1	RDCLR	LECRA2	RCL	CAMRC1	RC1
3	RC1		RDCOMP		RCOMP	CAMF03	F03
4			RDCAM4			CAMF04	F04
5			RDCAM5			CAMF05	F05
6			RDCAM6			CAMF06	F06
7			RDCAM7			CAMF07	F07
8	LST	TLM	LTEST	TESTAP	RLAM	CAMTLM	TLM
9	RAZ1	CL1	CLEAR1	RAZ1	CLEAR	CAMCL1	CL1
10	LZT	CLM	LCLEAR	TESRAP		CAMCLM	CLM
11	RAZ2	CL2	CLEAR2	RAZ2	CLEAR2	CAMCL2	CL2
12			CAM12			CAMF12	F12
13			CAM13			CAMF13	F13
14			CAM14			CAMF14	F14
15			CAM15			CAMF15	F15
16	WR1	WT1	WRTCAM	ECRGR1*	WRITE	CAMWT1	WT1
17	WR2	WT2	WRTCM2	ECRGR2	WRITE2	CAMWT2	WT2
18	WS1	SS1	WRSCAM	OCRGR1	BISET	CAMSS1	SS1
19	WS2	SS2	WRSCM2	OCRGR	BISET2	CAMSS2	SS2
20			WRCM20			CAMF20	F20
21		SC1	WRCM21		BICLR	CAMSC1	SC1
22			WRCM22			CAMF22	F22
23		SC2	WRCM23		BICLR2	CAMSC2	SC2
24	DIS	DIS	DISABL	MISHOR*	DISABL	CAMDIS	DIS
25	TSI	XEQ	INCREG	INCREM	EX	CAMXEQ	XEQ
26	DIS	ENB	ENABLE	MISEN*	ENABLE	CAMENB	ENB
27	TST	TST	CMSTAT	TESTA*	RSTAT	CAMTST	TST
28			CAM28			CAMF28	F28
29			CAM29			CAMF29	F29
30			CAM30			CAMF30	F30
31			CAM31			CAMF31	F31

* The S & V language includes several mnemonics for functions 1, 16, 24, 26, 27. Only one of each set is shown in the table.

The implication is that in those cases, if a non-standard or reserved function code is required, the numerical value must be written (either always with three characters e.g. F08, or with two or three characters as necessary e.g. F8).

It would clearly be advantageous to have greater uniformity of mnemonics. The particular sets shown illustrate some possibilities, but we note below some further points for consideration. It would be possible to change the mnemonics in particular implementations without serious problems.

There are two broad classes of use which account for an important difference between the mnemonics:

(a) functions specified in a context already established as CAMAC (e.g. the first parameter in an SA statement in IML);

(b) functions specified in a context not necessarily CAMAC (e.g. the procedure names in a subroutine implementation).

The mnemonics can satisfactorily be shorter in class (a) than class (b), since for the latter they must be distinguished from all other names which can occur in the same context, and identify themselves as CAMAC functions. A satisfactory solution could, however, be achieved by constructing names for class (b) from a constant CAMAC identifying part together with a class (a) mnemonic for the function. This is illustrated in the last two columns of the table.

Notes on Individual Mnemonics (by F Value)

0, 2, 9, 16, 21: Act on group 1 register. Should the mnemonic include a 1 for group 1, or should this be taken as the normal default? Alternatively, if digits are to be used in mnemonics for non-standard and reserved functions, it might be preferable to designate the groups of registers in a module as 'group A' and 'group B' rather than 1 and 2.

1, 11, 17, 19, 23: Act on group 2 register. There must be a distinguishing code for these, but the 2 is unsatisfactory: the Trumps mnemonic for F(1) has the same form as for F(4)-F(7) but if interpreted in that way would denote F(2).

25: The 1972 version of EUR 4100 defines F(25) as Execute whereas the 1969 version was Increment preselected registers. The Trumps mnemonic refers to the old standard.

REFERENCES

CAT11 : A simple CAMAC language for the PDP-11.
F. Golding, Daresbury, 1973.

IML : IML Macro Expansion Syntax (SWG 2/74).
P.J. Hagan, Oxford, 1974.

K : A. Katz, Saclay, 1974.

S & V : 'An Approach to a CAMAC Language'.
M. Sarquiz and P. Valois, *CAMAC Bulletin*, 2 (1971) 20.

Trumps: The PDP-10 Based On-line Data Collection System.
M.P.H. Davies, S.M. Haddon, P.J. Hagan, R. Hunt, B.E.F. Macefield and C.A. Wilkinson.
Oxford Nuclear Physics Laboratory, September 1973.

NEWS

HOW TO CONTACT CAMAC WORKING GROUPS

Everybody who is interested in further information on the activities of the CAMAC Working Groups or who would like to obtain advice for the application of CAMAC specifications is invited to contact the appropriate chairman or secretary of the existing working groups. The corresponding addresses are given below.

ESONE-CAMAC WORKING GROUPS

Dataway Working Group (EDWG)

Chairman: R. Patzelt, Technische Hochschule Wien, 1040 - Wien, Gusshausstr. 21, Austria.

Secretaries: R.C.M. Barnes and I.N. Hooton, both of Electronics and Applied Physics Div., Building 347.2, AERE Harwell, Didcot, Berks. OXON, England.

Software Working Group (ESWG)

Chairman: I.N. Hooton, see above.

Secretary: A. Lewis, Electronics and Applied Physics Div., AERE Harwell, Didcot, Berks. OXON, England.

Analogue Signals Working Group (EAWG)

Chairman: Th. Friese, Hahn-Meitner-Institut für Kernforschung Berlin GmbH, 1 Berlin 39, Glienickerstr. 100, Germany.

Mechanics Working Group (EMWG)

Chairman: F.H. Hale, Electronics and Applied Physics Div., Building 347.2, AERE Harwell, Didcot, Berks. OXON, England.

Information Working Group (EIWG)

Chairman: H. Meyer, CBNM EURATOM, Steenweg naar Retie, 2440 Geel, Belgium.

NIM-CAMAC WORKING GROUPS

Dataway Working Group (NDWG)

Chairman: F.A. Kirsten, Lawrence Berkeley Laboratory, University of California, Berkeley, Ca. 94720, U.S.A.

Secretary: S.J. Rudnick, Argonne National Laboratory, P.O. Box X, Oak Ridge, Tennessee 37830, U.S.A.

Serial Systems Sub-group

Chairman: D.R. Machen, Los Alamos Scientific Laboratory, University of California, LAMPF/MP-1, Los Alamos, New Mexico 87544, U.S.A.

Systems Compatibility Sub-group

Chairman: D. Horelick, Stanford Linear Accelerator Center, Stanford University, P.O. Box 4349, Stanford, California 94305, U.S.A.

Software Working Group (NSWG)

Chairman: R.F. Thomas, Jr., Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544, U.S.A.

Secretary: W.K. Dawson, University of Alberta, Dept. of Physics, Edmonton, Alberta, Canada.

Mechanical and Power Supplies Working Group (NMWG)

Chairman: L.J. Wagner, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720, U.S.A.

Analogue Signals Working Group (NAWG)

Chairman: D.I. Porat, Stanford Linear Accelerator Center, Stanford University, P.O. Box 4349, Stanford, California 94305, U.S.A.

ESONE ANNOUNCEMENTS

ESONE SECRETARIAT

All correspondence with the ESONE Committee should now be directed to the new provisional address of the ESONE Secretariat:

Dr. H. Meyer
Commission of the European Communities,
CRC - CBNM
B-2240 Geel,
Belgium

Tel. No.: 32-14-589421
Telex: 33589 Euratom B

2

DESIGN CONSIDERATIONS FOR A SERIAL DRIVER

by

R. Conway, H. Halling and D. L. Abbott

Kernforschungsanlage Jülich, Germany

Received 18th July 1974

SUMMARY This paper presents ideas concerning the implementation of the Serial Driver as a transparent interface between a user program and the CAMAC crates attached to the Serial Highway. The implementation combines hardware and software to provide the electrical connections and intelligent handling of errors in the Serial system.

INTRODUCTION

The CAMAC Serial Highway[1] provides interconnections between CAMAC crates and a System Controller. In particular a Serial Driver (SD) has been described which has an output port and an input port between which the Serial Highway (SH) forms a unidirectional loop. The Serial System can be viewed as a combination of hardware and software which allows a user to carry on I/O with the various CAMAC crates connected to this loop. In this scheme the user program is executed by a master computer system which provides all support necessary for the user program to perform its function. The sophistication of this support may vary widely. It may include an operating system with facilities for mass storage and terminal I/O, or it may contain a full multi-tasking monitor, but in all cases the SD provides the connection to the SH for the master computer system and thus for the user program. This paper describes work in progress on an implementation of the Serial Driver which combines software and simple hardware to provide a transparent interface between the CAMAC crates connected to the loop and the user program. It is intended as a presentation of ideas which may stimulate further thinking in the area.

DESIGN GOALS

The primary goal of our SD design is to make the SH as transparent as possible to the user program. We consider an IML[2] statement imbedded in the user program to be a port which provides CAMAC I/O capabilities but also isolates that program from the particular system of CAMAC interconnections. Thus a serial system and a parallel system should be as nearly indistinguishable as possible to the user program. As part of achieving this transparency we wish to determine the amount of intelligent error recovery that could be performed by the SD, thus doing as much as possible to provide the user program with only valid I/O. Finally, we wish to identify those functions of a Serial Driver which could most effectively be implemented in hardware for a given performance requirement.

These goals dictate four general functions which should be performed by the SD:

- All electrical considerations of driving the SH — This includes clock generation and automatic generation and reception of continuous delimiters between messages.
- Formatting of messages for the SH — This involves a translation of CAMAC Read, Write, and Control Functions into command messages and the generation of transverse and longitudinal parity.
- Buffering of demand messages — Demand messages may appear at any time (between other messages) on the SH and they must be received immediately. This places a real-time constraint on the user software which does not necessarily reflect any urgency in the demands themselves. For this reason the SD should queue demands as they arrive so that a demand handler program may service them, as appropriate, while new demands continue to be received by the SD. This again is an effort to make the SH transparent to the user.
- Error control — This includes both checking for errors in incoming messages and any intelligent recovery techniques which may be possible.

Assumptions

In implementing these functions we have made certain assumptions about the behavior of the programs using the Serial Driver which should be made quite clear. Firstly, it is assumed that the user program does not 'pipeline' I/O on the serial system. This means that IML statements are translated into CAMAC functions which are executed sequentially one at a time. For each function the SD program is called, the command is transmitted, the reply is received and the SD returns control to the user program. Secondly, no attempt is made by the SD to identify the priority assigned to demands by the user program. Each demand is queued as received and the demand handler provided by the user or the master is informed. This places the full burden for servicing demands according to their priority on the appropriate user program. We have tried, however, to make the servicing as convenient and free from the real-time constraints imposed by the SH as possible. Thirdly, the user program must have the capability of dealing with severe errors in the serial system. The SD program will describe errors via the operating system and identify them with the relevant status variable, but we consider it good practice to always return control to the calling program which must, therefore, be capable of dealing with the errors.

DESCRIPTION

The block diagram of our design is shown in Fig. 1. An available hardware module [3,4] provides

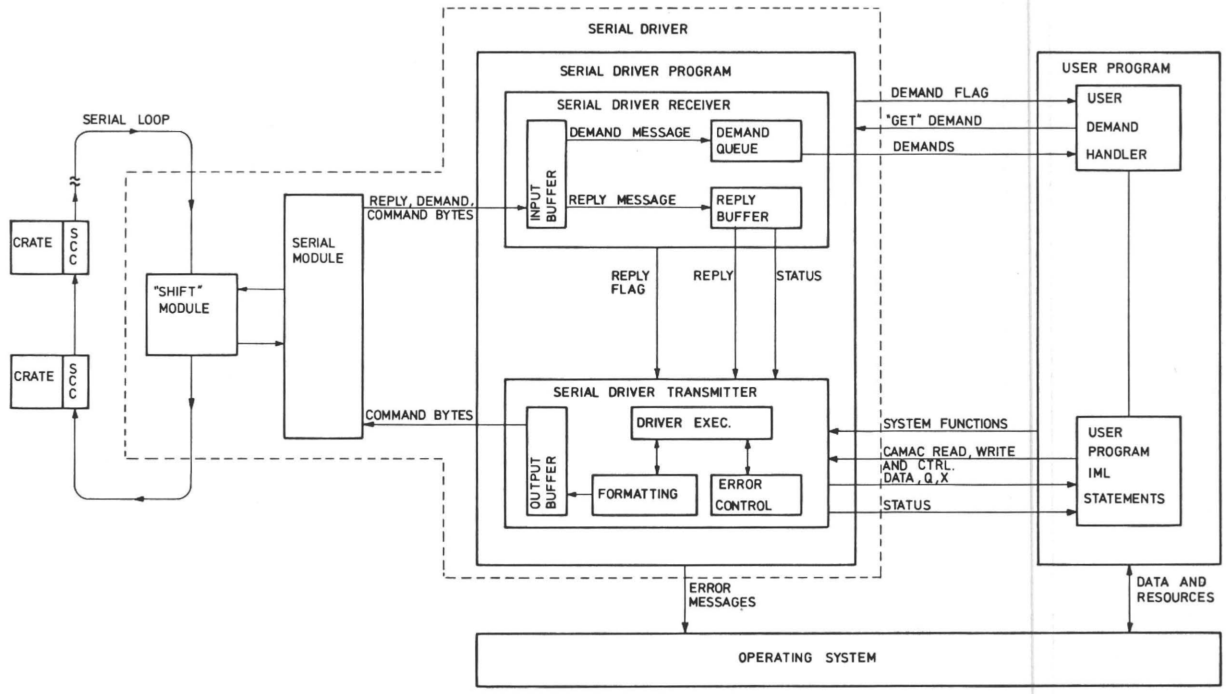


Fig. 1 Block Diagram of Serial Driver

the required connection to the SH as well as driving, transmission and reception capabilities. This Serial Module does automatic transverse parity generation during transmission and allows the SD program to deal only with message bytes. As each byte is received the hardware checks its parity and uses the eighth bit as a parity error flag, thus easing the job of the software.

Serial Driver Program

The Serial Driver Program functions between the Serial Module, the user programs, and the programs of the master. Communication between the SD Program and this environment is carried out via well defined ports or links. It is only through these ports that information passes in or out of the program. We can identify them as follows:

- IML statements — A user program is written in a host language in which are imbedded IML statements. In our implementation these IML statements are translated via macros to CAMAC Read, Write and Control functions which in turn are translated to calls to the SD Program. Upon completion of the action, status and data are passed back to the user program.
- Serial System function calls — A user program also communicates with the SD program via serial system calls which request action on the serial system itself. These actions include loop-collapse procedures and initialization procedures.
- Message bytes sent and received — The Serial Module provides flags to the SD program when message bytes may be transmitted and when they are received by the module. The SD Program then loads a byte into the module or reads a byte from the module.

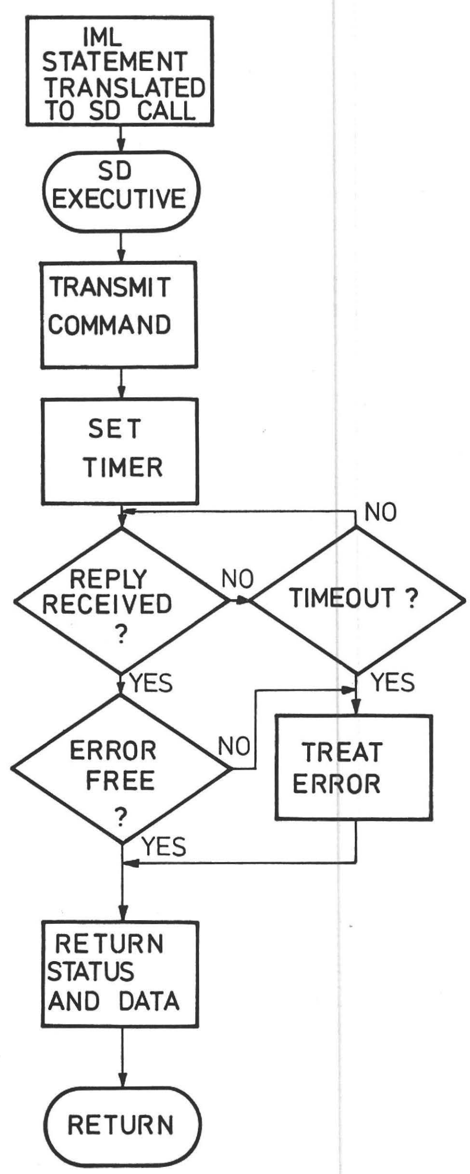


Fig. 2 Function of Serial Driver Executive Procedure →

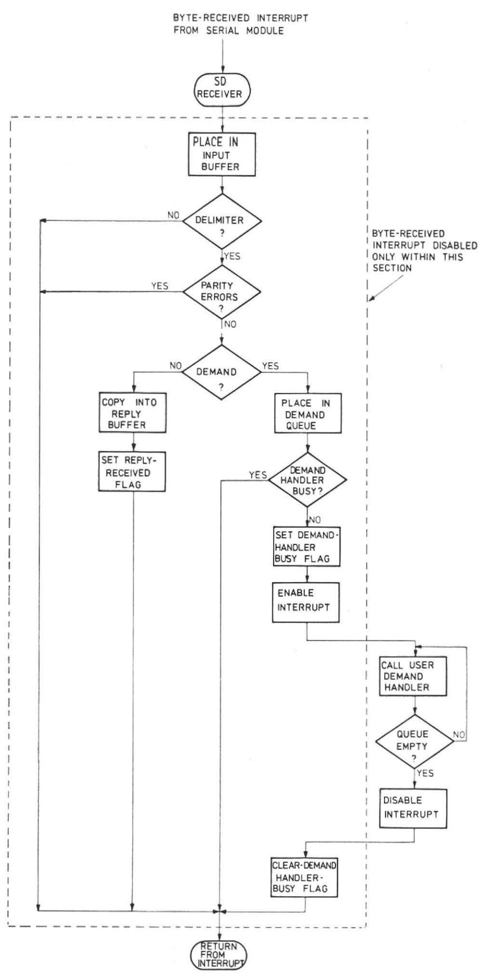


Fig. 3 Function of Serial Driver Receiver Procedure

- A transfer mechanism to the Demand Handling Procedure of the user — After a demand message is received by the SD program and the demand is queued the SD must have a means of transferring control to the Demand Handling Procedure which cooperates with the user program. The procedure may be within the user program itself or it may be provided by the master. In our implementation it is a procedure provided by the master and available to any user program. When a demand is received by the SD Program it is queued, and control is transferred to the Demand Handling Procedure via a vector.
- Demands passed to the demand handler — When the Demand Handling Procedure has been invoked by the SD program it must remove demands from the demand queue for servicing. The demands are removed by requesting them from the SD Program.
- Error messages — If severe errors occur in the system, the SD Program requests the host operating system to print a message describing the failure before returning to the user program.

The internal structure of the SD Program basically consists of an Executive and Error Control Procedure, a Transmitter which formats messages and passes them byte by byte to the Serial Module, and a Receiver which is invoked by interrupt whenever a byte is received by the Serial Module.

The handling of calls from the user by the Executive Procedure and of received bytes by the Receiver Procedure are shown in Fig. 2 and 3, respectively. It is important that the following points be well understood. The processes of transmitting and receiving a message are independent in our design. A call to the SD by the user causes the Executive to call the Transmitter and await either a flag indicating that a complete, ungarbled reply has been received or a time-out flag indicating that it has waited too long for the reply, before returning to the user program.

Quite independently the Receiver is invoked by the Byte-Ready interrupt from the hardware module and the Reply-Received flag is set when a reply, free of parity errors, is received. It is only via this flag and the buffer which contains the reply that the two processes communicate. Moreover, the Receiver Procedure is actually an interrupt service routine which must be able to respond each time a byte is received by the hardware. This places a definite constraint on the amount of time which may be spent within the routine.

Those functions of the SD which are performed by the hardware in our implementation were selected only as a matter of convenience: the modules were immediately available to us. However, as stated above we wish to explore areas which could be performed by hardware in the future. The Kinetics model 3992 Serial Highway Driver[5] represents an implementation of a different subset of the functions of the SD in hardware. This implementation would significantly ease the task of the transmitter and receiver procedures in our implementation but the basic task of providing a transparent interface to the SH user would of course remain.

ERROR CONTROL

The techniques for handling errors in the SD program are not clearly defined and, although it is possible to make initial suggestions, the final judgements must await observation of the serial system working under typical conditions. Recognizing this we have been careful to separate error handling procedures from other code in the SD program so that they may be easily modified at any time.

A significant difference between the serial and parallel CAMAC systems is that one would normally operate a parallel system in an error free environment, but the serial system can be used in an error prone environment. Although it is possible for a SD to do some error recovery the fact remains that, in addition to knowing that each CAMAC action was successfully performed, the user program must have a means of knowing that each action was successfully transmitted to the status variable declared for each IML Action Statement.

As seen from the SD, errors in the Serial System can be separated into three levels or scopes which are nested within one another. These scopes are distinguished by the mechanism by which the errors are detected and by the methods with which they are treated. The innermost scope is that of a message received by the SD. In this scope errors are detected by the geometric error detection code included in the message. If it contains parity errors, then no further information can be extracted from a message with absolute certainty. In particular, since the message contains bits identifying its type (i.e. reply, demand or command) and these bits cannot be trusted, the Receiver Procedure cannot further handle the message and it must be discarded. Note that detection and treatment of errors within this scope are without regard to the type of message and are carried out within the Receiver Procedure.

Progressing outwards the next scope is that of the command-reply sequence. When the SD executive sends a command message it expects a specific reply. Errors regarding that reply may be detected as follows:

- Time out before reply is received — As discussed above this may mean that the reply arrived but contained more than one bit in error.
- Reply received but contains ERR bit set — This indicates that the command was garbled as it arrived at the addressed crate.
- Command returned without reply — This may mean that the addressed crate is bypassed.

The method used to treat these errors depends specifically upon the command-reply sequence in progress. Furthermore the treatment takes place within the Executive Procedure itself. For example if a reply is received with the ERR bit set the Executive sends the command a second time. If it again fails a message is passed to the master's operating system for printing and it returns to the user with the status variable set to indicate the error.

The outermost scope is that of the State-of-the-Loop. Errors in this scope are independent of any particular command-reply sequence. They include such things as a break in the loop which is detected by the hardware when no bytes are received after a certain period of time, or the destructive failure of a Serial Crate Controller which destroys the message structure on the loop. These errors may be treated by special procedures within the Serial Driver or by a user program communicating with the SD via serial system function calls.

The treatment of errors varies from the simple printing of an error message identifying the error, to sophisticated strategies based on the context of an error and assumptions about the probable distribution of errors in the serial system. In general our implementation takes the safest and simplest approach to this treatment.

REFERENCES

1. CAMAC Serial System Organization — A Description, USAEC NIM Committee TID 26 488, ESONE Committee ESONE/SH/01. December 1973.
2. Hooton, I.N., Hagan, P.J., Introduction to the CAMAC Intermediate Language. AERE Harwell, Report AERE-R7578, October 1973.
3. Brandenburg, G., Serial CAMAC Module. *CAMAC Bulletin*, No. 9, March 1974, p. 13.
4. Abbott, D.L., SHIFT — A Serial Highway Interface for Teletypes. *CAMAC Bulletin*, No. 10, July 1974, pp. 19-20.
5. Kinetics System Corporation. CAMAC Serial Highway Driver Module 3992. May 1974.

NEWS

CAMAC COURSES AT HARWELL

The next and 15th two-day course on the CAMAC Standard at the Harwell Education and Training Centre will be on the 18/19th March, 1975. It is intended for users of CAMAC, rather than for equipment designers, and deals with the CAMAC specifications covering the Dataway, Parallel Branch Serial Highways and IML. The principles of modules and controller are illustrated by practical examples and there are visits to installed systems. Since the course first started in 1969, more than 400 have attended and approximately 60% of these were from organisations external to the UKAEA.

The course fee is £30, exclusive of accommodation, and application forms are obtainable through the Education and Training Centre, AERE Harwell, Oxfordshire OX11 OQJ. Early application is advisable because there is a restricted number of 30 places per course.

CAMAC AT THE 2ND ISPRA NUCLEAR ELECTRONICS SYMPOSIUM

The 2nd Ispra Nuclear Electronics Symposium will be held on May 20-23, 1975. There will be at least one CAMAC session dealing with new CAMAC developments, or more depending on the number of papers received. The Symposium will take place at Stresa (Lago Maggiore) and be accompanied by an instrument exhibition with an area set aside for CAMAC equipment and systems.

For additional information, please write to:

Professor L. Stanchi,
EURATOM C.R.C.,
21020 Ispra,
Italy.

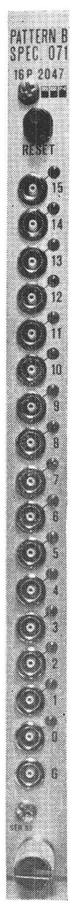
Mr. C. Ciniselli,
Via Al Doyro 6,
CH-6815 Melide,
Switzerland.

NEW PRODUCTS

DATA MODULES
(I/O Transfers and Processing)

Digital Parallel Input Modules

Improved 16 Input Pattern Unit



An improved version of the 16P 2047 (*CAMAC Bulletin* No. 6) is now available, which retains the compact and flexible characteristics of the original model, but also displays the status of individual inputs by means of 16 front-panel LEDs.

Ref. SEN Electronique

Optically Coupled Input Register

The Joerger Enterprises Model IR-2 contains a 24-bit, optically coupled Input Register packaged in a single-width module. The register may be loaded continuously or strobed with an external signal. The register clock may be inhibited under program control to prevent data update and is always inhibited when the module is addressed on its N line to prevent errors in data readout. A LAM flip-flop is provided and will be set by any data bit that is in a logic '1' state. Provision is made to terminate each data input. Standard units are provided with 1 K ohm inputs but other termination can be supplied to meet various system requirements such as line impedance or drive capability. Input signal conditioning can also be provided for especially noisy environments. The module is also available with its chassis isolated from signal ground if required.

Functions Used: F0, 1, 8, 9, 10, 24, 26
Module Width: Single
First Shipment: 6/74

Ref. Joerger Enterprises

Interrupt Alarm Register

The JIR 10, conforming to CERN specifications (73-19) is designed for handling 16 independent interrupt or alarm inputs via front panel sockets.

Masked input bits are 'OR' ed to form a LAM signal which can be enabled on the L line or on the rear panel socket for connection to a higher priority interrupt level.

The inputs (unterminated CAMAC connections) accept signals or pulses (minimum duration, 2 µs).

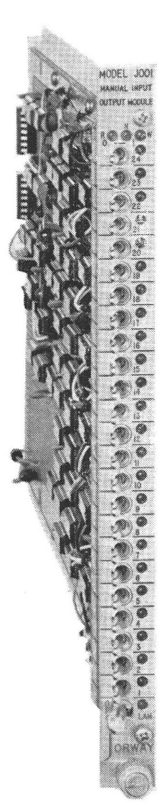
The levels are in accordance with the following conventions:

– Interrupt	'0'	(+5 V)	normal
	'1'	(0 V)	interrupt active
– Alarm	'1'	(0 V)	normal
	'0'	(+5 V)	alarm active

Straps are provided on the printed card for the selection of either ALARM or INTERRUPT conditions for each input.

Ref. Schlumberger Instruments & Systèmes

Manual I/O Unit



The Model 201 Manual Input/Output unit is a single-width module that provides the means to manually input data to the Dataway-Read lines and to display Dataway-Write-line information.

A 24-bit, toggle-switch register on the front panel controls the entry of data which is gated onto the Dataway-Read lines on command.

Dataway-Write-line data is stored in a 24-bit, output-storage register on receipt of an overwrite command. In addition individual bits of the output register may be selectively set or cleared by an appropriate command with the Write-line data selecting the bits affected. The states of the output register are displayed by 24 LED indicators on the front panel.

Three LED indicators are provided to indicate that the module is addressed and that Read or Write commands are being performed. The signals to these indicators are stretched so that even single commands are visible.

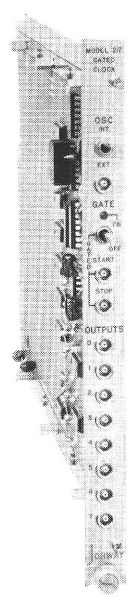
A switch is provided for manual generation of a Look-at-Me request which, once set, is maintained until cleared by command. A Test Look-at-Me operation produces a Q response if a LAM is present. A LED indicator is illuminated when a LAM is pending.

The Model 201 conforms to CAMAC specifications AEC TID-25875 (EUR 4100e – 1972).

Ref. Jorway Corporation

Digital Output Modules

Gated Clock



The Model 217 Gated Clock is a single-width CAMAC module providing up to eight decade-divided outputs derived from an internal 10MHz oscillator. To expand the versatility of clock generation for system use, none of the eight outputs are assigned to a particular clock frequency. Internal jumpers are provided so that the user can assign the appropriated frequency to each output thereby improving fanout capacity. For example four outputs can all be assigned a 10MHz output while the remaining outputs are assigned lower frequencies.

All outputs can be gated in synchronism with the basic oscillator. After application of a start or stop pulse the clock outputs will be gated at the next negative transition of the oscillator assuring uniform output clocks. Two gated output modes may be selected by internal straps. Mode 1: All clock outputs begin simultaneously with a negative-going transition when gated on. Mode 2: 10MHz outputs begin with a negative-going transition and all other outputs have negative-going transition after their respective clock period i.e., 1 µsec for 1 MHz, 1 sec for 1 pps etc. A selectable external clock input is provided to enable operation at other frequencies.

Ref. Jorway Corporation

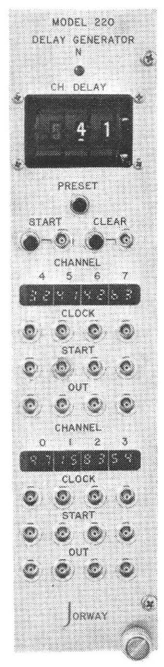
Output Register

The JRS 30, conforming to CERN specifications (73-19), will be used for data transfers to peripheral equipment, either two or four peripherals (2 × 16 bit words or 4 × 8 bit words). In particular the byte mode is very useful for transfer of ASCII code data.

- An OR strobe output, logical 'or' of all strobe signals is available on the front panel (unterminated CAMAC signal)
- A fused + 6V/1A supply is provided to power external logic.

Ref. Schlumberger Instruments & Systèmes

8-Channel Delay Generator



The Model 220 Delay Generator is a triple-width module providing eight individual delay channels. Each delay channel provides an output pulse which is delayed by N times input-clock interval. N may be set from 0 to 99. Each channel has an individual clock and an individual start input. For longer delays, channels may be cascaded by connecting the output of one channel to the start input of the next channel.

Channel delays may be set manually by a front-panel, thumbwheel switch or by appropriate commands on the CAMAC dataway. Dataway delays are in binary form for integers 0 to decimal 99. Each channel has a two-digit display showing the current delay in appropriate channel. Delays set are not cleared by clear or initialize functions. Clearing and initialize stop the delay generator and reload the stored delay in each appropriate channel for the next operation.

Delay begins at the next negative-going clock transition after a start (negative-going) pulse has been applied. If the clock is already low (approximately 0.4 volts) the delay will begin with the start pulse. This assures the negative-going delay output can be used to synchronously start cascaded channels.

A common start and clear function are provided for controlling all channels simultaneously.

Options are available for special output signals on a 36-pin edge connector located above the normal dataway connector.

Ref. Jorway Corporation

Digital I/O, Peripheral and Instrumentation Interfacing Modules

Optically Coupled I/O Register

The Model IOR-1 provides a 24-bit Input Register and a 12-bit Output Register in a single-width module. The Input Register is optically coupled and the Output Register has a 50 ma complementary output designed to drive twisted pair or optically coupled inputs. The Input Register may be loaded continuously or strobed by an external signal. The Input Register's clock will be inhibited each time the module is addressed on its N line to ensure readout of error-free data and, in addition, may be disabled under program control to lock in data. A LAM flip-flop is provided that will be set if any data bit in the input register is at a logic '1'. Each input is terminated, normally with 1K ohm, although other termination can be provided to meet various system requirements such as line impedances or drive capability. Input signal conditioning can also be provided for especially noisy environments. This module is available with the chassis isolated from the signal ground if required.

Functions Used: F0, 1, 8, 9, 10, 16, 24, 26
Module Width: Single
First Shipment: 5/74

Ref. Joerger Enterprises

16-bit Input/Output Register IOR 2053

This is a single-width module containing one 16-bit input and one 16-bit output register fed by a single front-panel connector, and providing parallel transmission between two systems. When transmission between more than two systems is required, this can be handled bi-directionally by a single line, and a bridge on the printed circuit card provides for selection of this mode. The unit is designed for 'Handshake' data transfers with two front-panel LEDs indicating that such a transfer is taking place.

In order to provide real interface flexibility, the 16 stages of the output register are mounted on a pluggable printed circuit card which can be exchanged at will. Any output levels may be used, and a full range of production stages is available, including opto-coupled units.

The 2053 is an efficient and adaptable module, intended for use in mini-computer managed systems where speeds of up to one megaword are required, and designed to provide the most economical method of inter-system communication.

Ref. SEN Electronique

Terminal Driver

The unit JTY 20 has been designed for coupling terminals to a CAMAC crate. The input/output circuits use the standard 20mA current loop over a wide range of transmission speeds. This allows the JTY 20 to be coupled to many types of terminals: teletypes, display terminals, etc.

- A LAM is generated at the end of the data conversion, parallel-to-serial or serial-to-parallel, according to transfer direction.
- A switch located on the front panel, selects one of seven transmission speeds: 110, 300, 600, 1200, 2400, 4800 and 9600 bauds.
- Testing on Q response permits operation in repeat mode.
- Three sources of errors are detected: parity error, error on stop bits, reading error.

Ref. Schlumberger Instruments & Systèmes

Analogue Modules

16-Channel ADC

The Model AM-1 contains a 16-channel, solid-state multiplexer and an 11-bit, plus-sign, integrating Analogue to Digital Converter. The multiplexer is two pole, capable of handling 16 differential analogue inputs. The input range is ± 10 volts. All channels are continuously scanned, analogue data converted, and loaded into memory. Output data is read out of memory. This allows the most efficient use of the converter and simplifies system operation. The scanner and the dataway operation are totally independent. To permit the monitoring of a single channel continuously, the scanner may be inhibited and the channel address selected under program control.

OPTIONS AVAILABLE: 8 Channel Unit
3½ Digit BCD Output
Fast A/D Converter

Functions Used: F0, 1, 16
Module Width: Double
First Shipment: 6/74

Ref. Joerger Enterprises

6-Channel Time Digitizer

The Joerger Enterprises Model TD is a six-channel, time digitizer. Its primary application is for spark-chamber readouts. It contains six, 16-bit counters capable of counting a clock in excess of 100MHz. Each channel contains centre-finding logic to ensure accurate results. The input logic is such that the channels may be selected for any number of sparks and, therefore, there are no dead or unusable channels. An overflow bit is provided for each channel and also a bit to indicate if more sparks were received than expected. Each channel may be tested under dataway control.

Also available are complete CAMAC timing systems including crate, clock, a scanner or Type A-1 controller and scalers (max. 138 channels per crate).

Functions Used: F0, 9, 25
Module Width: Single
First Shipment: 8/74

Ref. Joerger Enterprises

Quad Digital-to-Analogue Converter

A new single-width unit is available equipped with four DAC's, separate registers and analogue outputs (Model C-DA-408 with 8-bit word length and Model C-DA-410 with 10 bits) for the analogue control of external equipment.

The standard output voltage range is 0 to +5V; other ranges are optional (0 to +10V, 0 to +2V, 0 to +1V, −10V to +10V, −5V to +5V, −1V to +1V, etc.).

Output signals settle to $\pm 0.1\%$ within 10µsec (within 100nsec with an optional fast output).

A ground-noise rejection feature is optionally available to compensate for an eventual floating of the analogue ground level of connected equipment. Timing signals can be applied to control the transfer of the analogue signals.

Ref. Wenzel Elektronik

SYSTEM CONTROL
(Computer Couplers, Controllers and Related Equipment)

Interfaces/Controllers/ Drivers for Serial Highway

CAMAC Serial Highway Driver

The Serial Highway Driver, Model 3992 is a triple-width CAMAC unit interfacing the dataway of a CAMAC crate to the serial highway, following the serial system organization as described in the ESONE document, ESONE SH/01 (identical with USAEC NIM doc. TID 26488).

Bit-serial and byte-serial posts for data and clock are provided for transmitting command messages and for receiving reply and demand messages. All functions of the unit are controlled by the dataway.

Serial messages are initiated by dataway operations involving command and data registers. Transverse and longitudinal parity are checked on incoming messages. The clock is variable from 5 KHz to 5 MHz.

Ref. Kinetic Systems Corporation

Serial Crate Controller

The Model 74 Serial Crate Controller, Type L-1, provides the interface between the CAMAC dataway and the standard serial highway developed by the ESONE-NIM Committees. The controller incorporates both bit- and byte-serial modes of operation, user selectable, and operates at clock rates in excess of 5 MHz.

Other features of the controller include a powerful error detection scheme, a method of error recovery and an improved versatile demand handling technique.

The Model 74 complies with current proposals for L-1 controllers described by the ESONE-NIM Committees as well as all the provisions required in EUR 4100e.

Ref. Jorway Corporation

Units Related to 4600 Branch or Other Parallel Mode Control/Data Highway

Branch Highway Terminator BHT 2055

The BHT 2055 is a single-width module conforming to the latest EUR 4600 specifications. It is supplied complete with the connecting cable for a Type A Crate Controller, such as the SEN ACC 2034, and no additional cables or connectors are required. One of the most important features of the 2055 is the ability to monitor the principal signals on the branch via the 14 front-panel outputs.

Ref. SEN Electronique

TEST EQUIPMENT

Dataway Related Testers and Displays

Dataway Display

The Model 202 Dataway Display unit is a single-width module used to display signal conditions on the CAMAC dataway. Front-panel LED indicators display the status of all dataway lines. Two modes of operation, Latch and Track, are selectable by a front-panel switch. The Latch mode provides for latching dataway signals during an appropriate (S1 or S2) dataway signal. All signals are stored except S1, S2, and Busy which are stretched and illuminate their appropriate indicators for approximately 100 ms. This mode allows the user to store the events of an individual dataway cycle. A manual clear is available to clear all latches on command. In the Track Mode the display follows the status of the dataway lines regardless of the dataway timing signals S1, S2, and Busy. This is often used in crate troubleshooting or in locating defective signal lines.

The Model 202 conforms to CAMAC specifications AEC TID-25875 (EUR 4100e – 1972).

Ref. Jorway Corporation

CRATES, SUPPLIES, COMPONENTS, ACCESSORIES

Crates and Related Components/Accessories

300 W Powered Crate PC 2057

The PC 2057 is a standard CAMAC crate of advanced design, conforming to the specifications laid down in CERN document No. 46-01.

The power supply is a pluggable unit which is carried on guides fitted with an automatic lock and is composed entirely of replaceable printed circuits. Both the power supply and ventilator sub-chassis can be withdrawn completely without having to remove the crate itself from the rack.

There is increased current available on the ±6 V and ±24 V, and although the 12 V has been omitted in the standard CAMAC power supply, a NIM unit to the same mechanical specs is available and can be installed in a few seconds.

Both 110 V AC and 200 V DC are provided, and neon warning-lights indicate when either is switched on. Comprehensive overload and overheat protection is fitted, incorporating warning lamps, audio alarm and cut-off switches.

Ref. SEN Electronique

Index to Manufacturer's News and New Products

NEWS

A FAST MULTI-EVENT TIME DIGITISER

G. Huxtable, P. Dolley and J. Argyle, at Harwell, report that they have a CAMAC time-digitiser designed primarily for neutron time-of-flight measurements on the Harwell Synchrocyclotron, although other applications requiring a time-resolution of 1.25 nano-seconds are possible. The basic time-reference is a 100 MHz free-running clock and a delay-line method of interpolation provides a channel-width deviating by no more than 1% from its nominal value of 1.25 nano-seconds. The dead-time per event is 110 nano-seconds and hardware 'first-in, first-out' registers can hold up to 18 digitised events of 20 time-bits, giving over a million channels in a time-range of 1.3 milliseconds.

BULLETIN ANNOUNCEMENTS

PREPARATION OF CONTRIBUTIONS

Authors are requested to follow these instructions when submitting contributions for the Bulletin. Failure to do so may result in contributions being returned to the author for re-submission in a modified form, and may delay publication.

1. *English is the preferred language. Contributions in other languages are equally welcome but only the summary will be translated.*
2. *Authors should state their name, business affiliation and postal address on a separate sheet if not included in the contribution.*
3. *The style, layout, use of bibliographic references and so on should follow as closely as possible the appropriate contents of this Bulletin.*
4. *For contributions to the New Products Section, each product description should be on a separate sheet and* ***any one description must not exceed 250 words or 1/3 Bulletin-page, including illustrations.***
5. *For contributed articles, 1 200-1 600 words are preferred.* ***They must not exceed 2 000 words or 3 Bulletin-pages, including illustrations.*** *They should be accompanied by a summary (abstract) suitable for translation into other languages and preferably not exceeding 50 words.*
6. *Manuscripts should be typed on alternate lines on only one side of the page.*
7. *Drawings and photographs should be included if they are relevant to the text. Original ink (not pencil) drawings and semi-mat prints of photographs, at least twice the final size, should be submitted. The author's name and the figure number should be written, lightly, in pencil on the back of each illustration. A list of all figure numbers and captions should be included on a separate sheet, even if these are given in the text or on the illustrations themselves.*
8. *Articles which are shortened, or adapted from, original papers should identify the original in the references.*
9. ***Authors must submit contributions before the closing dates*** *announced elsewhere in this Bulletin.*
10. *Reprints can be ordered at any time, but authors who are likely to require reprints in bulk should request these when submitting a contribution.*

NEWS

ANNOUNCEMENTS BY CAMAC MANUFACTURERS

APPLIED COMPUTER SYSTEMS LIMITED are pleased to announce that their CAMAC testing aid (CATY) mentioned in Bulletin No. 10 has now been modified and is currently being used on both 4K and 8K PDP-11 computers with the following controllers:

1. DARESBURY SINGLE & MULTI CRATE;
2. GEC;
3. NUCLEAR ENTERPRISES;
4. WENZEL ELEKTRONIK.

ACSL are currently preparing a pamphlet on 'Different PDP-11 controllers from a software viewpoint'.

More information on both these subjects can be obtained from ACSL.

COMPUTER TECHNOLOGY SA announce that they have received an order for a system worth 10 000 000 B.Fr. from the Société Rhône Progil, a French chemical company, for use in their research laboratory in Paris. This system provides simultaneous facilities for monitoring laboratory instruments, remote job entry to an IBM 370 and local processing.

COMPUTER TECHNOLOGY will provide their Multilab Package for laboratory instrument control and their Satellite operating system (SATOS) which simultaneously enable remote job entry and local processing. The satellite software will enable a Hasp workstation. This multi-purpose system is made possible by the use of a real-time executive and operating system, MODUS 4. The hardware will include two processors, 56K of store, a fixed head disc and a communications multiplexer. The laboratory interface is based on two CAMAC controllers and some application software will be developed by Harwell experts.

The European Space and Technology centre (ESTEC) located in Noordwijk, Holland, and which is part of ESRO, has just ordered two MODULAR ONE systems to integrate into their check-out stations for the European METEOSAT satellite. This is the second contract for COMPUTER TECHNOLOGY SA with ESTEC and follows the order in 1973 by the ESRO organisation of two equivalent systems for the GEOS project.

COMPUTER TECHNOLOGY will deliver to ESTEC bi-processor systems which are driven by the new MODUS 4 software. Each configuration will include the two MODULAR ONE processors, 72 Kwords (16-bit) of fast core memory, a 1 Mword disc system, 3 magnetic tape units and several other peripherals, such as the 600 lpm line printer and alphanumeric visual displays.

The applications programs will be in CORAL 66 a very powerful language which is based on a similar bloc structure as ALGOL.

The different telemetry, telecommand and other related special equipment will be directly connected to the MODULAR ONE systems through the special CAMAC interfaces built up by LOGICA Ltd.

IDAS (Informations-, Daten- und Automationssysteme GmbH) has developed a software package for communication with CAMAC process-peripherals: CASPAC (CAMAC-Software-Package). It consists of a system of re-entrant assembler routines which allow a communication with CAMAC process-peripherals using CAMAC single-word transfer mode as well as block transfer mode on FORTRAN and assembler level.

It is possible to formulate interrupt actions in the form of an arbitrary sequence of CAMAC transfers on FORTRAN level.

CASPAC does not need an operating system and, therefore, can be used autonomously as well as in connection with a real-time or batch operating system. CASPAC has been implemented for a system with a DEC-PDP-11 computer and Schlumberger ICP-11 CAMAC controller. 740 words of memory are needed in the basic implementation.

ACTIVITIES OF THE APPLICATIONS WORKING GROUPS OF THE EUROPEAN CAMAC ASSOCIATION (ECA)

Industrial Working Group

Chairman: K. G. Hilton, GEC-Elliott Process Automation Ltd., New Parks, Leicester LE3 1UF, England.

The European CAMAC Association set up a Working Group at its Council Meeting in May, to consider problems of the application of CAMAC in industry.

This group has now held two meetings and is examining and considering problems of hardware, particularly in relation to environment and ergonomics.

Views have been expressed that some aspects of CAMAC are not ideal in industrial conditions and it is important that these aspects should be looked at carefully in this growing area of application.

The Working Group plans to consider this important question in some detail and also to look at problems of cabling to CAMAC modules and of software for this type of system.

The Working Group would be interested to hear from anyone, particularly with experience of using or applying CAMAC in industrial or environmentally hostile environments, who would be interested in taking part in this activity or who would like to make any comment or offer any information.

Medical Working Group

Chairman: E. Rehse, Neurosurgical Clinical Hospital of the University, Düsseldorf, Germany.

The Medical Working Group of ECA held its first meeting on September 5th, 1974 in Düsseldorf. In an initial general discussion it was agreed that the meeting serve the purpose to establish a preliminary list of future activities for the Working Group. In order to do so it was decided to collect as much information as possible about existing or planned medical CAMAC applications.

This information will be collected by means of a questionnaire, sent out to medical CAMAC users. The Working Group will evaluate the outcome.

The list of possible future activities contains patient safety regulations with regard to CAMAC, interfacing and connecting medical transducers to CAMAC, input specifications of future medical CAMAC units, etc.

It is intended to establish and update currently a list of medical congresses, symposia, meetings and perhaps publications of interest and relevance to medical CAMAC applications.

NEWS

NORD COMPUTERS WITH CAMAC IN ACCELERATOR LABORATORY OF AARHUS UNIVERSITY, DENMARK

The Institute of Physics at the University of Aarhus has ordered one NORD 10 and four NORD 12 computers from Norsk Data-Elektronik A/S, Norway. The NORD 10 will be a central computer for the four NORD 12 minicomputers each equipped with a CAMAC system. The accelerator control and experiment data taking for two accelerators will be independently handled by the system. The choice of the system was inspired by the CERN contract with Norsk Data-Elektronik.

The CAMAC interface will be supplied by the computer manufacturer while the CAMAC equipment itself will be set up by the Institute.

The central computer has the SINTRAN III real-time operating system taking care of all communications with the satellite computers and also the CDC 6400 of the University.

Programming is possible in assembler language or in high level languages of either the compiled or the interpretive types.

PAPER ABSTRACTS TRANSLATIONS

A Computerised Air Pollution Monitoring System in Bavaria
J. Landbrecht

Summary

A multi-component air pollution monitoring system is being installed in Bavaria. CAMAC equipment controlled by computers of the PDP-11 family is used extensively for measurement, data acquisition and teleprocessing in the many widely-dispersed measurement stations and in the central station.

Zusammenfassung

In Bayern wird ein Netz zur Überwachung der Luftverschmutzung errichtet. Zur Messung, Datengewinnung und Fernverarbeitung in den zahlreichen, weitverstreuten Meßstationen und in der zentralen Station wird ein von einer PDP-11 gesteuertes CAMAC-Gerät eingesetzt.

Résumé

Un système de contrôle de la pollution de l'air à composants multiples est en cours d'installation en Bavière. L'équipement CAMAC contrôlé par des ordinateurs de la série PDP-11, est utilisé de façon intensive pour les mesures, la collecte des données et le télétraitement dans des stations de mesure nombreuses et dispersées ainsi que dans la station centrale.

Riassunto

È stato installato in Baviera un sistema di controllo dell' inquinamento atmosferico a più componenti. Le attrezzature CAMAC controllate da calcolatori della famiglia PDP-11 vengono ampliamente impiegate per le misure, l'acquisizione di dati e il teletrattamento nelle numerose stazioni di misura disperse in una vasta area, e nella stazione centrale.

Samenvatting

Een uit verschillende componenten bestaand systeem voor de controle op de luchtverontreiniging wordt in Beieren geïnstalleerd. Voor de metingen, de data acquisitie-en verwerking, wordt in de verschillende ver uiteengelegen meetstations en in het centrale station, op grote schaal gebruik gemaakt van CAMAC-apparatuur, bestuurd door PDP-11 computers.

Резюме

Много-элементную систему мониторования загразнения воздуха строится в Баварии. Аппаратуру CAMAC управляемую ЭВМ РДР-11 используется для измерении, сбора данных и дистанционной обработки в многих широко разброшенных измерительных станциях как и в центральной станции.

On-Line Control of a Synchronous Generator using CAMAC
M. E. Newton and B. W. Hogg

Summary

A laboratory system has been constructed to study direct-digital-control of turbogenerators in electric power systems. It consists of a model power system, connected to a hierarchical computer system through a CAMAC interface.

Zusammenfassung

Zur Untersuchung der digitalen Direksteuerung von Turbogeneratoren in Kraftwerken ist eine Anlage für Laborbetrieb gebaut worden. Sie besteht aus dem Modell eines Kraftwerks, das über einen CAMAC-Anschluß mit einem hierarchisch aufgebauten Computer-System verbunden ist.

Résumé

Un système de laboratoire a été mis au point en vue d'étudier la commande numérique directe des turbogénérateurs dans les systèmes électriques de puissance. Il est constitué d'un modèle de système électrique relié par une interface CAMAC à un système d'ordinateurs hiérarchisé.

Riassunto

È stato costriuito un sistema di laboratorio per studiare il controllo numerico diretto dei turbogeneratori nei sistemi di generazione di corrente. Esso consiste di un modello di generatore collegato ad un calcolatore a gerarchia attraverso un'interfaccia CAMAC.

Samenvatting

Beschreven wordt een laboratoriumopstelling voor de bestudering van directe digitale besturing van turbogeneratoren in electriciteitsnetten. Het bestaat uit een model van een electriciteitsnet dat via CAMAC aan een centraal computersysteem gekoppeld is.

Резюме

Ралрабомана лабораторная система для исследования прятого управления турбогенератором в энергетических системах. Она состоит из модели энергетической системы подключенной к иерархической системе ЭВМ через интерфейс CAMAC.

A Fast Multi-User CAMAC System for Data Acquisition, with Autonomous Controllers
Per Høy-Christensen

Summary

This multi-user multi-crate CAMAC system for data acquisition is controlled by an RC 4000 computer, and uses command generators for autonomous transfers. Look-at-Me demands are serviced through the Branch Highway, in conjunction with control highways within each crate. Some applications of the system are described.

Zusammenfassung

Das mehrere Rahmen umfassende CAMAC-System, gleichzeitig verwendbar für mehrere Teilnehmer, wird für die Datengewinnung von einem Rechner RC 4000 gesteuert; es arbeitet mit Befehlsgeneratoren für autonome Übertragungen. LAM-Anforderungen werden über den Branch Highway in Verbindung mit Steuer-Sammelschienen in den einzelnen Rahmen verarbeitet. In dem Bericht sind einige Anwendungen des Systems beschrieben.

Résumé

Ce système CAMAC multi-châssis, multi-utilisateurs, destiné à l'acquisition de données est relié à un ordinateur RC 4000; il utilise des génerateurs d'ordres pour les transferts autonomes. Les appels LAM sont traités par l'Interconnexion de Branche en liaison avec une interconnexion de commande à l'intérieur de chaque châssis. Description de diverses applications du système.

Riassunto

Questo sistema CAMAC a più contenitori e per più utenti per acquisizione di dati è controllato da un calcolatore RC 4000 e usa unità di comando per trasferimenti autonomi. I richiami sono trattati attraverso il collegamento del ramo principale in relazione a rami di controllo di ciascun contenitore. Si descrivono alcune applicazioni del sistema.

Samenvatting

Dit multi-user multi-crate CAMAC systeem voor data acquisitie wordt bestuurd door een RC 4000 computer en maakt gebruik van command generators voor de autonome transporten. Bij de verwerking van de Look-at-Me signalen wordt gebruik gemaakt van een combinatie van de Branch highway en de control highway (Harwell 7000 Serie). Verder worden nog enige toepassingen van het systeem beschreven.

Резюме

Многокрейтная, многодоступная система CAMAC для сбора данных управляется ЭВМ RC-4000 и пользуется генераторами коммaнд для автономных передачи. Запросы LAM обслуживается через магистраль ветви и управляющий магистраль вне крейта. Описаные некоторые применения системы.

CAMAC Read-Out System for Wire Spark-Chambers or Multi-Wire Proportional Chambers
M. Pernicka and L. Pregernig

Summary

This system includes a dual 16-bit read-in module, with variable-threshold differential inputs for the signals from the ferrite core store of a wire spark-chamber or the amplifiers of a multi-wire proportional spark-chamber. A 16-channel ferrite-core-store driver module generates output pulses of adjustable amplitude, width and polarity.

Zusammenfassung

Das System umfaßt einen Eingabemodul mit zwei 16-Bit-Empfangsregistern und differentiellen Eingängen mit variabler Schwelle für die Signale aus dem Ferritkernspeicher einer Funkenkammer oder den Verstärkern eines Proportionalzählrohrs mit mehreren Zähldrähten. Eine Treiber-Einheit mit 16 Kanälen generiert Ausgabeimpulse, deren Amplitude, Breite und Polarität einstellbar sind.

Résumé

Ce système comprend un tiroir d'entrée de 2×16 bits à entrées différentielles à seuil variable pour les signaux émis par la mémoire-ferrite d'une chambre à étincelles ou par les amplificateurs d'une chambre proportionnelle multifils. Un module de commande de mémoire ferrite à 16 canaux émet des impulsions de sortie dont l'amplitude, la largeur et la polarité sont réglables.

Riassunto

Il sistema comprende un doppio modulo di lettura a 16 bit, con ingressi differenziali a soglia variabile per i segnali provenienti dalla memoria a nuclei di ferrite di una camera a scintilla a filo o dagli amplificatori di una camera a scintilla proporzionale multifilo. Un modulo di comando con memoria a nuclei di ferrite a 16 cannali genera impulsi d'uscita di altezza, larghezza e polarità regolabile.

Samenvatting

Beschreven wordt een 2×16-bits inleesmodule met differentiële ingangen. De discriminerende ingangen (met instelbare drempel) zijn geschikt voor de signalen van het ferriet kerngeheugen van een draadvonkkamer en voor de signalen van veeldraads proportionele vonkkamer versterkers. Ten behoeve van het testen van ferrietkernen is een 16-kanaals core-store driver ontwikkeld. Dit module genereert pulsen waarvan amplitude, breedte en polariteit instelbaar zijn.

Резюме

Система содержает двойной 16-разрядный блок с диффеpенциальным входом и переменным порогом для считывания сигналов из ферритовой памяти проволочной искровой камеры или-же из усилителей пропорциональной камеры. 16-канальный драйвер памяти генерирует импульсы с устоновочной амплитудой, шириной и полярностью.

Optical Link for the CAMAC Branch Highway through a Screened Cage
A. J. Putter

Summary

Plasma physics experiments cause enormous electro-magnetic interference, and therefore measuring equipment is usually situated in a screened cage. For data communications to a central computer the CAMAC parallel Branch Highway passes through the wall of the screened cage via an optical link.

Zusammenfassung

Da plasmaphysikalische Experimente eine sehr starke elektromagnetische Interferenz bewirken, wird die Meßausrüstung gewöhnlich in einer abgeschirmten Kammer untergebracht. Zur Übertragung der Daten auf einen zentralen Rechner führt der parallele CAMAC-Branch Highway über eine optische Verbindung durch die Wand der abgeschirmten Kammer.

Résumé

Les expériences effectuées dans le domaine de la physique des plasmas provoquent des interférences électro-magnétiques considérables, d'où la nécessité de placer l'équipement de mesure dans une cage de Faraday.
Pour transmettre les données à un ordinateur central, l'Interconnexion de branche parallèle CAMAC traverse la paroi de la cage par le truchement d'un couplage optique.

Riassunto

Negli esperimenti di fisica del plasma esistono enormi interferenze elettromagnetiche e pertanto le apparecchiature di misura sono normalmente situate in una gabbia schermata.
Per la trasmissione di dati al calcolatore centrale il collegamento al ramo principale CAMAC parallelo passa la parete della gabbia schermata attraverso una connessione ottica.

Samenvatting

Plasma-fysische experimenten veroorzaken zeer grote electromagnetische stoorsignalen, de gebruikte meetapparatuur wordt daarom in een afgeschermde kooi geplaatst. De meetapparatuur is d.m.v. CAMAC met een centrale computer gekoppeld. Ter vermijding van ongewenste aardlussen wordt de Branch highway via een optische koppeling door de wand van de afschermkooi gevoed.

Резюме

Эксперименты в области физики плазмы вызывают больщие электро-магнетические помехи и поэтому измерительную аппаратуру помещается в экранированной клетке. Для передачи данных в центральную ЭВМ пропускается магистраль параллельной ветви CAMAC через стену клетки с помощю оптической связи.

A Fast Digital Multiplier for CAMAC
P. Hawkins

Summary

This CAMAC module has been developed at CERL for telecommunication-signal cross-correlation in an experimental power-system protection scheme. It multiplies two 12-bit numbers in 280 ns.

Zusammenfassung

Dieser CAMAC-Modul ist bei den CERL für die Kreuz-Korrelation von Fernmeldesignalen in einem experimentellen Kraftwerks-Schutzsystem entwickelt worden. Er multipliziert zwei 12-Bit-Zahlen in 280 ns.

Résumé

Ce module CAMAC a été mis au point au CERL pour la corrélation des signaux de télécommunication dans un projet de protection d'un générateur de puissance expérimental. Ce module permet de multiplier deux nombres de 12 bit en 280 ns.

Riassunto

Questo modulo CAMAC è stato sviluppato presso il CERL per l'intercorrelazione di segnali di telecomunicazione in uno schema di protezione di un sistema sperimentale di potenza. Esso multiplica 2 numeri da 12 bit in 280 ns.

Samenvatting

Dit CAMAC-module werd door CERL ontwikkeld voor de kruiscorrelatie van telecommunicatiesignalen in een experimenteel systeem voor de beveiliging van elektriciteitsnetten. Het vermenigvuldigt twee getallen van 12 bits in 280 ns.

Резюме

Этот блок разработан в CERL для определения кросскорреляции сигналов связи в экспериментальной установке защиты энергетических систем. Он умножает два 12-разрядные числа в течение 280 нсек.

A CAMAC Interface for Tektronix Waveform Digitizers
J.-P. Vanuxem

Summary

A CAMAC module has been designed, as a result of collaboration with Tektronix, to interface the Digital Processing Oscilloscope (DPO) and the Transient Digitizer (R7912) to the CAMAC Dataway.

Zusammenfassung

Als Ergebnis der Zusammenarbeit mit Tektronix ist ein CAMAC-Modul für den Anschluß des digitalen Verarbeitungsoszilloskops (Digital Processing Oszilloscope) und des transienten Analog-Digital-Umsetzers (R7912) an den CAMAC-Datenweg, entwickelt worden.

Résumé

En collaboration avec Tektronix, un module CAMAC a été conçu pour relier le «Digital Processing oscilloscope» (DPO) (Oscilloscope numérique) et le digitaliseur transitoire (R7912) à l'Interconnexion CAMAC.

Riassunto

È stato progettato un modulo CAMAC in collaborazione con la Tektronix quale interfaccia del Digital Processing Oscilloscope (DPO) e del convertitore Transient Digitizer (R7912) per l'Interconnessione CAMAC.

Samenvatting

In samenwerking met Tektronix werd een CAMAC-module ontwikkeld als interface tussen de Digital Processing Oscilloscope (DPO), resp. de Transient Digitizer (R7912), en de CAMAC-dataway.

Резюме

В сотрудничестве с фирмой Тектроникс разработан блок интерфейса CAMAC для Цифрового Обработивающего Осциллоскопа (ДРО) и Дигитайзера Переходных Процессов (R7912).

A System Controller for SIGMA 2/3 RXDS Computers
M. Wiemers and B. Martin

Summary

This system controller for program-controlled operations interfaces the SIGMA 2/3 RXDS computer to the CAMAC Branch Highway. It was developed in order to introduce CAMAC into the Max-Planck-Institut für Kernphysik, as no other controller for the SIGMA 2/3 computer was available.

Zusammenfassung

Diese Systemsteuerung für programmgesteuerte Operationen verbindet den Rechner SIGMA 2/3 RXDS mit dem CAMAC-Branch Highway. Sie ist entwickelt worden, um das CAMAC-System im Max-Planck-Institut für Kernphysik einzuführen; eine andere Steuerung für den Rechner SIGMA 2/3 war nicht verfügbar.

Résumé

Ce contrôleur de système relie le canal programmé de l'ordinateur SIGMA 2/3 RXDS à l'Interconnexion de Branche CAMAC. L'appareil a été construit afin de permettre l'utilisation de CAMAC au « Max-Planck-Institut für Kernphysik » qui ne disposait d'aucune autre interface pour l'ordinateur SIGMA 2/3.

Riassunto

Questa unità di controllo di sistema per operazioni controllate a programma fa da interfaccia fra il calcolatore SIGMA 2/3 RXDS e il collegamento del ramo principale CAMAC. Essa è stata sviluppata per introdurre CAMAC nel Max-Planck-Institut für Kernphysik dato che non era disponibile nessuna altra unità di controllo per il calcolatore SIGMA 2/3.

Samenvatting

Deze system controller maakt geprogrammeerde I/O transporten mogelijk tussen de CAMAC Branch highway en de SIGMA 2/3 RXDS-computer. Tot de ontwikkeling werd besloten omdat geen andere controller voor de SIGMA 2/3 computer ter beschikking stond.

Резюме

Этот контроллер системы сопрягает ЭВМ Sigma 2/3 RXDS с магистралью ветви CAMAC. Он разработан для введения CAMAC-а в институте Макса Планка.

Mnemonics for CAMAC Functions

I. C. Pyle

Summary

In CAMAC software it is convenient to use alphanumeric mnemonics to represent function codes. This paper reviews some existing sets of mnemonics for CAMAC functions and derives a new proposal.

Zusammenfassung

Bei CAMAC-Programmen ist es vorteilhaft, alphanumerische mnemonische Zeichen zur Darstellung von Funktionscodes zu verwenden. In dem Bericht werden einige der vorhandenen Zeichenreihen für CAMAC-Funktionen geprüft; aus der Prüfung wird ein neuer Vorschlag abgeleitet.

Résumé

Dans le logiciel CAMAC, il est commode d'utiliser des mnémoniques alphanumériques pour représenter les codes fonctions.
Le présent article passe en revue divers systèmes de mnémoniques déjà employés pour les fonctions CAMAC et établit sur cette base une nouvelle proposition.

Riassunto

Nel software CAMAC è opportuno impiegare una mnemonica alfanumerica per rappresentare i codici delle funzioni. Nell'articolo si esaminano alcuni gruppi di codici mnemonici per funzioni CAMAC e si presenta una nuova proposta.

Samenvatting

De CAMAC functiecodes worden in de software bij voorkeur aangeduid met symbolische namen. Dit artikel geeft een overzicht van de reeds bestaande groepen mnemotechnische namen en presenteert daarnaast een nieuw voorstel.

Резюме

В области программирования системы CAMAC полезным является применение альфа-нумерических мнемонических символей для представления кодов операции. Сделан обзор некоторых существующих наборов символей и представленные новые предложения.

Design Considerations for a Serial Driver

R. Conway, H. Halling and D. L. Abbott

Summary

This paper presents ideas concerning the implementation of the Serial Driver as a transparent interface between a user program and the CAMAC crates attached to the Serial Highway. The implementation combines hardware and software to provide the electrical connections and intelligent handling of errors in the Serial system.

Zusammenfassung

Der Bericht befaßt sich mit dem Einsatz des seriellen Treibers als transparente Schnittstelle zwischen einem Benützerprogramm und den CAMAC-Rahmen, die mit dem seriellen Highway verbunden sind. Hardware und Software werden so kombiniert, daß die elektrischen Verbindungen vorhanden sind und eine geeignete Fehlerbehandlung in dem seriellen System möglich ist.

Résumé

Le présent article apporte différentes suggestions concernant la mise en œuvre de la Branche série, en tant qu'interface transparente entre un programme d'utilisateur et les châssis CAMAC reliés à cette Branche. Cette réalisation combine matériel et logiciel afin de fournir les liaisons électriques nécessaires et le traitement autonome des erreurs dans le système série.

Riassunto

Il documento presenta alcune idee sull'applicazione dell' unità di comando serie quale interfaccia trasparente fra un programma utente e i contenitori CAMAC collegati al ramo principale serie. Nell'applicazione si abbina l'hardware al software per ottenere un collegamento elettrico con buon trattamento degli errori nel sistema serie.

Samenvatting

In dit artikel worden enkele ideeën naar voren gebracht met betrekking tot het gebruik van de Serial driver als transparante interface tussen een gebruikersprogramma en de aan de Serial Highway gekoppelde CAMAC crates.
Hierbij zorgen hardware en software voor de noodzakelijke electrische verbindingen en voor een doeltreffende behandeling van fouten in het seriesysteem.

Резюме

Представлены идей касающиеся имплементации последовательного драйвера как прозрачного интерфейса между программой употребителя и крейтами CAMAC в последовательной ветви. Имплементация обхватывает оборудование и программы обеспечая электрическое соединение и разумную обработку ошибок в последовательной системе.

CAMAC BIBLIOGRAPHY

Specifications and Supplementary Information*

CAMAC: A Modular Instrumentation System for Data Handling. Description and Specification. EUR 4100e, CEC, Luxembourg 1972, 64 p., and AEC Report TID-25875, U.S.AEC, Washington DC, U.S.A., supercedes EUR 4100e (1969).

CAMAC: Organisation of Multi-Crate Systems. Specification of the Branch Highway and CAMAC Crate Controller Type A. EUR 4600e, CEC, Luxembourg 1972, 46 p. and AEC Report TID-25876, U.S.AEC, Washington DC, U.S.A.

CAMAC: Specification of Amplitude Analogue Signals, EUR 5100e, CEC, Luxembourg 1972, 10 p.

CAMAC: Supplementary Information on CAMAC Instrumentation System. AEC Report TID-25877, U.S.AEC, Washington DC, U.S.A., and Supplement to *CAMAC Bulletin* No. 6, CEC, Luxembourg, March 1973, 16 p.

CAMAC: Serial System Organization, a Description. ESONE/SH/01, ESONE Secretariat and TID-26488, U.S.AEC,Washington DC, U.S.A., December 1973, 83 p.

Addenda and Errata to: CAMAC Serial System Organization, a Description (ESONE/SH/01 and TID-26488). ESONE/SH/02, ESONE Secretariat, June 1974, 8 p.

CAMAC: Proposal for a CAMAC Language. ESONE Committee Software Working Group. Supplement to *CAMAC Bulletin* No. 5, CEC, Luxembourg, Nov. 1972, 42 p.

BARNES, R.C.M. A CAMAC Glossary. Supplement to *CAMAC Bulletin* No. 7, CEC, Luxembourg, July 1973, 18 p.

CAMAC Bibliography. Supplement to *CAMAC Bulletin* No. 8, CEC, Luxembourg, Nov. 1973, 16 p.

Recommended Introductory Reading

Proceedings of the 1st International Symposium on CAMAC in Real-Time Computer Applications, Luxembourg, Dec. 1973. (*)

DECKER, W. Measuring and Control System CAMAC. Siemens A.G. Karlsruhe, F.R. Germany, *Steuerungstechnik*, **6** (2), 1973, pp. 25-27 (in German).

FRIEDLE, T., HEEP, W., STIEFEL, W. CAMAC Data Logging System. Kernforschungszentrum Karlsruhe, F.R. Germany, KFK-1813, June 1973, 22 p.

ATTWENGER, W. Modular Instrumentation in Nuclear Electronics: Introduction to CAMAC. Österreichische Studiengesellschaft für Atomenergie GmbH, Seibersdorf, May 1973, 29 p. (in German).

COSTRELL, L. CAMAC Instrumentation System: Introduction and General Description. *IEEE Trans. Nucl. Sci.*, NS-20. No. 2, 1973, pp. 3-8.

KIRSTEN, F.A. CAMAC Specifications. *IEEE Trans. Nucl. Sci.*, NS-20, No. 1, Feb. 1973, pp. 562-568.

COSTRELL, L. CAMAC: A Review and Status Report. *IEEE Trans. Nucl. Sci.*, NS-20, No. 1, Feb. 1973.

WAGNER, F. CAMAC System. Pomiary, *Autom. Kontr.*, **18**, No. 11, Poland, Nov. 1972, pp. 508-510 (in Polish).

HOOTON, I.N. Standard Software for CAMAC-Computer Systems. Addendum of Supplement to *CAMAC Bulletin* No. 5, CEC, Luxembourg, Oct. 1972, 5 p.

ZACHAROV, B. CAMAC Systems: A Pedestrian's Guide. DNPL-R-23, Daresbury Nuclear Physics Laboratory, U.K., 1972, 44 p.

DECKER, W., STIEHL, W. CAMAC ein modulares Mess- und Steuersystem. *Siemens-Z.*, **46**, 1972, p. 233.

GALLICE, P., ROBIN, G. Système CAMAC. Informations pratiques pour son utilisation avec un calculateur. CEA-N-1549. CEA-SES-SESG-R-3135, France, 1972, 20 p.

BARNES, R.C.M., WHITEMAN, A.R.C. CAMAC Bibliography, Harwell Report AERE-Bib 180, U.K., 1972.

TRADOWSKY-THAL, I. CAMAC Bibliography. Kernforschungszentrum Karlsruhe, F. R. Germany, KFK 1471, 1971, 59 p. and KFK 1671, 1972, 56 p.

DE AGOSTINO, E., RISPOLI, B. Il sistema CAMAC. *Notiziario CNEN*, (18) No. 2, Italy 1972, pp. 55-72.

VOJINOVIC, M. Sistem Nuklearnih Instrumenata za Rad sa Racunskim Masinama CAMAC. *Nuklearna Energija*, **6**, No. 1, 1971, 19 p.

ISELIN, F. *et al*. Introduction to CAMAC. CERN, Report CERN-NP CAMAC Note 25-00, Switzerland, Jan. 1971, p. 51.

OTTES, J., TRADOWSKY, K. CAMAC - Ein System rechnergeführter Elektronik, Einführung und heutiger Stand. *Atomwirtsch.-Atomtechn.*, **16**, 1971, p. 516.

KINBARA, S. Introduction to the CAMAC System. *J. Atomic Energy Soc., Jap.*. **13**, 1971, p. 635 (in Japanese).

SARQUIZ, M. Review of the CAMAC System, Nuclear Instrumentation No. 42, CEA France. Supplement to *Bull. Inform. Sci. Techn.* No. 155, 1971.

Other Recent References**

INABA, S., SUGANO, K. CAMAC Readout System for Wire Spark Chamber. Tokyo Univ. Tanashi. INS-TH-84. 31 July 1973, 31 p., (in Japanese).

BARTEL, K. CAMAC: Preset Counter CZV-2. Österreichische Studiengesellschaft für Atomenergie GmbH, Seibersdorf. Aug. 1973, 17 p. (in German).

SCHWABACH, H., GRATEL, P., ATTWENGER, W. CAMAC-Interrupt-Register. Österreichische Studiengesellschaft für Atomenergie GmbH, Seibersdorf. Aug. 1973, 16 p. (in German).

BORCHERDING, K., KAUFMANN, R. CAMAC-Scaler-Timer-System with Computer Controlled Data Evaluation. Kernforschungszentrum Karlsruhe, F.R. Germany, KFK-1846, Sept. 1973, 46 p. (in German).

BERNEDE, M., DE GRANDI, G., KALISZ, J., STANCHI, L., EURATOM J. R. C., Ispra; BETTINI, P., NEGLIA, A., Società Elettronucleare Italiana, Milano. CAMAC Branch Driver, a Particular Solution. *Nucl. Instr. Meth.*, **112** No. 3, 1973, pp. 527-532.

GRUBER, P. H., OTTES, J. G. CAMAC System Controller for Process Computer Type Telefunken TR86. Kernforschungszentrum Karlsruhe, F. R. Germany, KFK-1873. Oct. 1973, 74 p. (in German).

GUERIN, J. P. CAMAC Modules Automatic Testing. CEA, Centre d'Etudes Nucléaires de Saclay. 16 Nov. 1973. 12 p. (in French).

MARSCHIK, W., SCHOEBERL, E. CAMAC: Test-Modul. Österreichische Studiengesellschaft für Atomenergie GmbH, Seibersdorf. Dec. 1973, 10 p. (in German).

PATRUTESCU, M. Modular System CAMAC. Institutul de Fizica Atomica, Bucharest. IPA-ER-4-1973. 31 p. (in Rumanian).

COATES, P. B. Distortion in the Measurement of Time-Interval Distributions. *Nucl. Instr. Meth.*, **113**, No.2, 1973, pp. 311-312.

BASILADZE, S. G., GVOZDEV, V. Ya., KOLPAKOV, I. F., MAN'YAKOV, P. K., TLACHALA, V. System of Fast Electronic Blocks for Physics Experiments, based on the CAMAC Standard. Joint Inst. of Nuclear Research, Dubna, USSR. *Instrum. Exp. Tech.*, **16**, No. 3, 1973, pp. 758-762.

MALTESE, P. Development of a Particle Detection Simulation System Using Electroluminescent Diodes Controlled by the Intermediate of a CAMAC Device. Strasbourg-1 Univ., 67, France, FRNC-TH-410, 1973, 93 p. (in French).

MEYER, J.M., MLYNEK, D., METZGER, G. Study of Data Transfer in the CAMAC Branch. CRNS Strasbourg, *Nucl. Instr. Meth.*, **111**, No. 2, 1973, pp. 263-268 (in French).

HERDAM, G., KUBITZ, M. CAMAC Branch Controller for Programmable Read-Only-Memories (PROM-BDC). Hahn-Meitner-Institut für Kernforschung Berlin GmbH. HMI-B-140, Sept. 1973, 44 p.

HELLMAN, G., OTTES, J.G. CAMAC Single Crate Controller for PDP-8/E Type Lem-52/32.1. Kernforschungszentrum, Karlsruhe, F.R. Germany. KFK-1719, July 1973, 26 p. (in German).

SCHWABACH, H., GRATEL, P., ATTWENGER, W. CAMAC 1 Timer-Counter. Österreichische Studiengesellschaft für Atomenergie GmbH, Seibersdorf. June 1973, 15 p. (in German).

SCHWABACH, H., ATTWENGER, W. CAMAC: Digitaler Multiplexer. Österreichische Studiengesellschaft für Atomenergie GmbH, Seibersdorf. June 1973, 19 p. (in German).

BUSCHBECK, F., NEUWIRTH, E. Proposal for a CAMAC Multicrate Serial Transmission System. Österreichische Studiengesellschaft für Atomenergie GmbH, Seibersdorf. May 1973, 28 p.

* Obtainable from: Office for Official Publications of the European Communities. Luxembourg, P.O. Box 1003.

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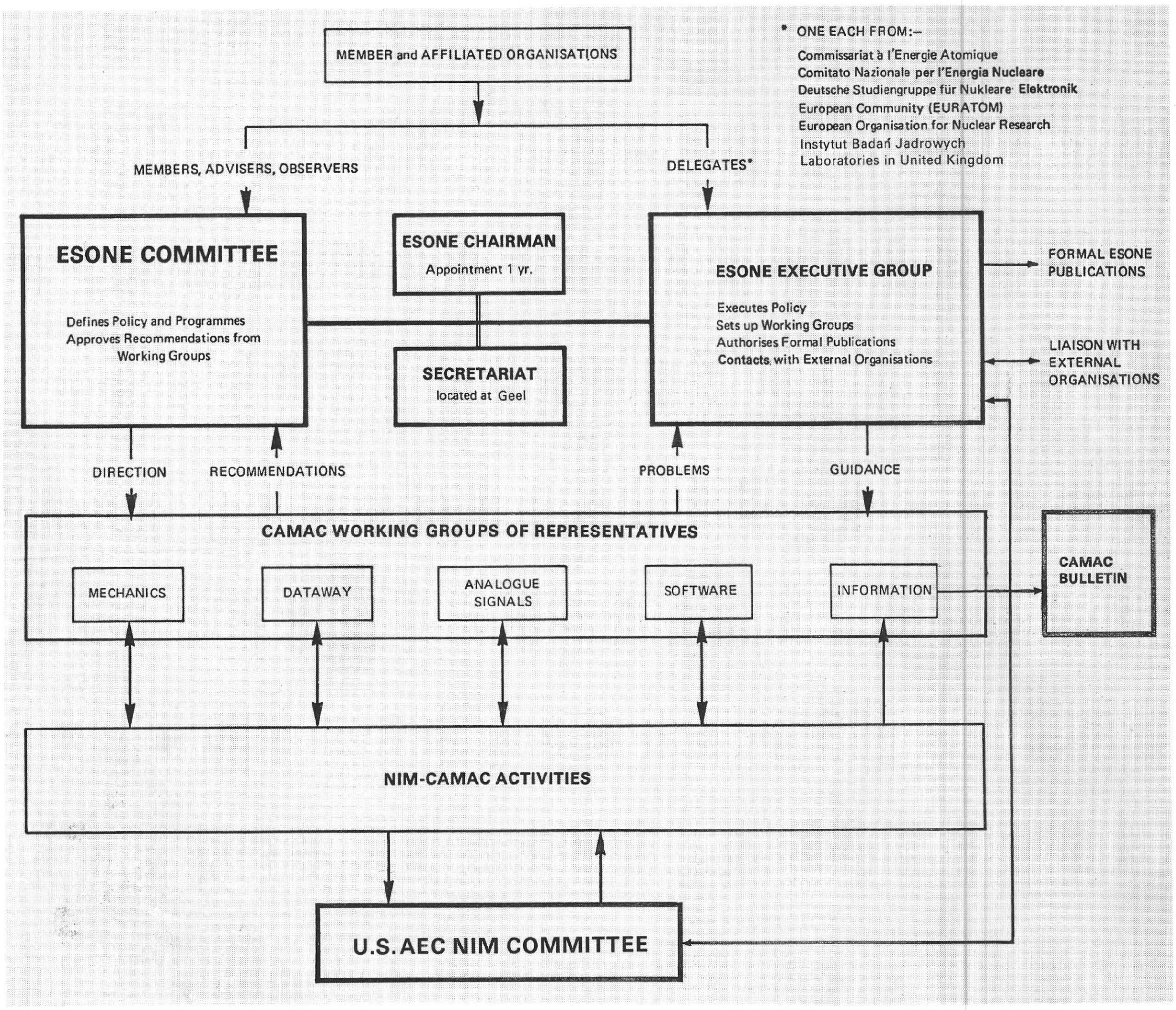

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