CAMAC

bulletin

A publication
of the
ESONE Committee

ISSUE No. 7
July 1973

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, JRC Euratom, I-21020 Ispra (Varese), Italy.

* ***DEADLINES FOR SUBMISSION*** **(issue No. 9)**
For articles and New Products: 26.10.73.
For Short News: 10.12.73.
For Product Guide and short news: 21.1.74.

On the cover:

View of the Johann-Strauss Monument (1825-1899) in the Stadtpark of Vienna, The ESONE Committee held its Annual General Assembly at Vienna, in 1967.

CAMAC

bulletin

CONTENTS OF THIS ISSUE

PAPERS RECEIVED

(first received up to March 15, 1973)

— Derandomizing CAMAC Input Module.
R. Klesse, Institut Max von Laue-Paul Langevin, Grenoble.
Paper foreseen but not inserted.

— A Data Acquisition System Based on CAMAC and Supported by Basic and Fortran.
D.A. Patourel, R.R. Johnson, D. Marquardt, D. Gurd, University of British Columbia, Vancouver

— Module Descriptor.
O.Ph. Nicolaysen, CERN, Geneva.

INTERNATIONAL ATOMIC ENERGY AGENCY

OFFICE OF THE
DIRECTOR GENERAL

KÄRNTNERRING 11,
A-1010 VIENNA 1.
AUSTRIA
(CABLE INATOM)

The advent of the CAMAC system at a time when instrumentation systems were proliferating wildly was a timely blessing for those concerned with the storage, retrieval and dissemination of data on the international level. The lack of standardization in such equipment had then become a serious obstacle to the free and rapid exchange of information which had to be surmounted in the interests of the scientific community, and, indeed, of the world at large.

The ESONE Committee, now comprising representatives from 38 laboratories in 15 European countries, set an example in international co-operation when it met with the express purpose of solving this problem. Standard schemes for integrated circuit elements (the CAMAC system) were developed as a first step towards compatibility of electronic equipment. Subsequent specialized working groups are continuing to concentrate on the wide range of aspects of this problem in an effort to achieve common practices and full interchangeability of equipment between the laboratories and institutes concerned.

As the Director General of the IAEA, one international organization which endeavours to foster the exchange of scientific and technical information on the peaceful uses of atomic energy, I can only welcome this achievement in standardization. It is to be hoped that further developments of the CAMAC system will meet with success equal to that already attained, and that those of us concerned with the dissemination of information will learn to make full use of them.

Sigvard EKLUND
Director General
International Atomic Energy Agency

Sigvard EKLUND

BIOGRAPHICAL NOTE

Born 1911. Dr. Sc., at Uppsala University. Senior scientist at the Nobel Institute for Physics and at the Research Institute for National Defence, Stockholm. Joined AB Atomenergi in 1950 as Director of Research and Deputy to the Managing Director. 1961 appointed Director General of the International Atomic Energy Agency.

APPLICATION NOTES

1

COMPUTER CONTROLLED MEASUREMENTS OF SEMICONDUCTOR DEVICES

by

P. Abend, H. Becker, D. Bräunig, R. Bublitz, G. Herdam, A. Spenker, H.-G. Wagemann and W. Wawer
Hahn-Meitner-Institut für Kernforschung Berlin GmbH, Berlin, Germany

Received 1st March 1973

SUMMARY A computer-controlled on-line data processing system with CAMAC instrumentation is used for fully automatic measurements on semiconductor devices such as transistors and Zener diodes. In addition to data acquisition, the computer controls and monitors the continuous measuring sequence.

INTRODUCTION

Measurements of large quantities of semiconductor devices such as transistors and diodes for production control, quality selection, or reliability tests are normally performed automatically with hardware specially adapted to particular characteristic parameters and to the general performance of the devices. This performance is known from preliminary investigations or experience and therefore only a few specific measurements are required for each element to obtain sufficient information about the detailed quantitative behaviour of a device.

If however, detailed analysis of the device performances is desirable and if the number of devices of a specific type is small, specially adapted hardware for automatic measurements procedures is expensive and measurements performed manually are time consuming. Then computer controlled systems, with flexible data analysis under software control, are well suited and more powerful. A computer controlled system with CAMAC instrumentation has been applied to the testing of irradiation-resistant semiconductor devices for the French-German telecommunication satellite project 'Symphonie' (Fig. 1).

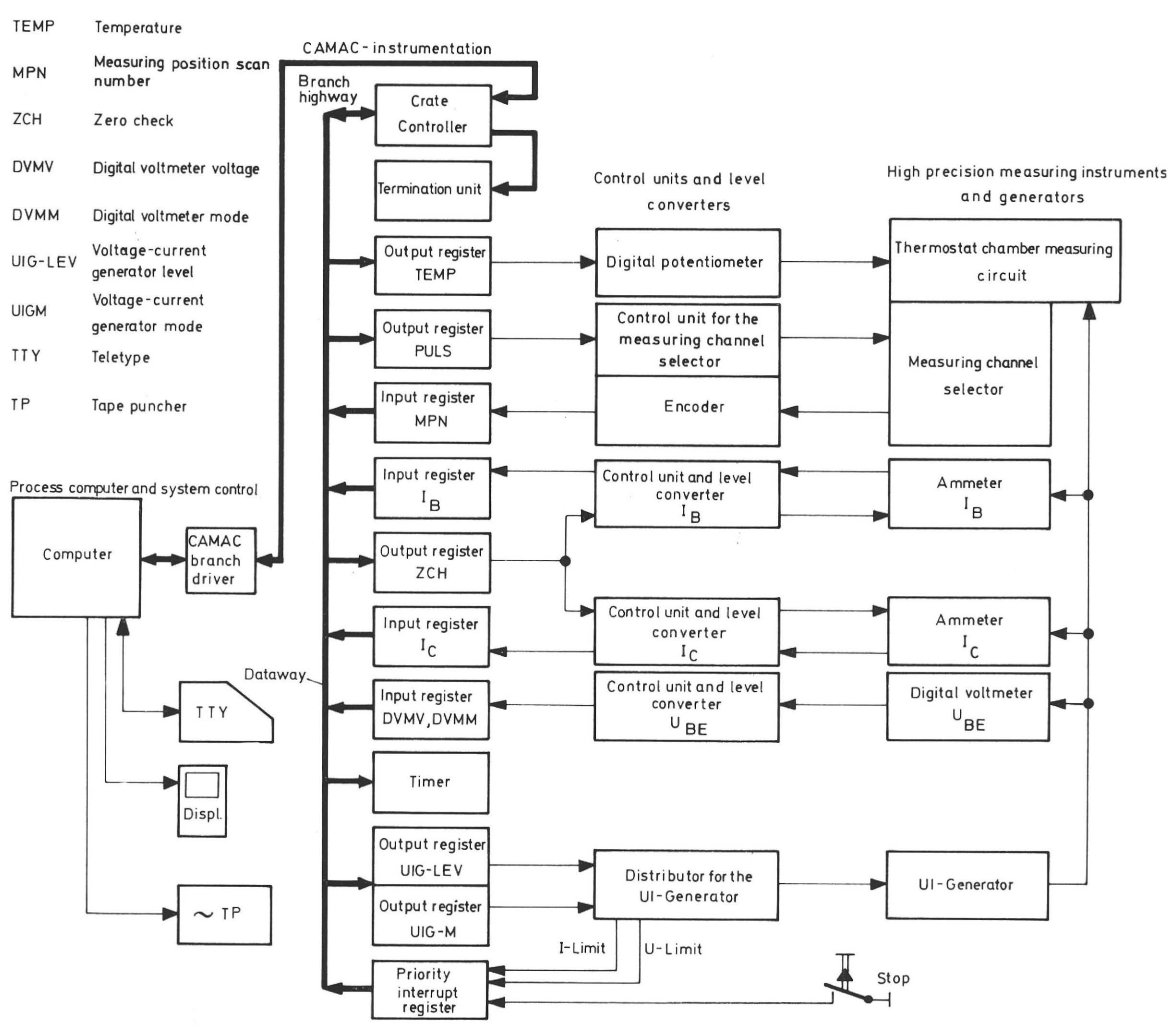


Fig. 1 Computer Controlled Measuring System with CAMAC-Instrumentation

A voltage/current generator, a channel selector, and a temperature chamber are connected to the CAMAC crate via control and level adapter units with common earth connection. To a great extent, the plug-in units in the CAMAC crate are input or output registers. They are used for digital control of the temperature chamber, the channel selector, and the voltage or current applied to the devices under test, and for transfer of data and status information.

Measurements and controls are performed with a flexible computer program which allows modification of parameters and measuring procedures by user-interaction via a teletypewriter. The evaluated data are presented on a graphic display for on-line monitoring and are recorded on paper tape.

MEASUREMENT PROCEDURE

Measurements are performed according to a defined procedure under program control. Fig. 2 shows the flow diagram for the measurement of the forward characteristics of a transistor. The diagram is self-explanatory and therefore only some additional remarks are given.

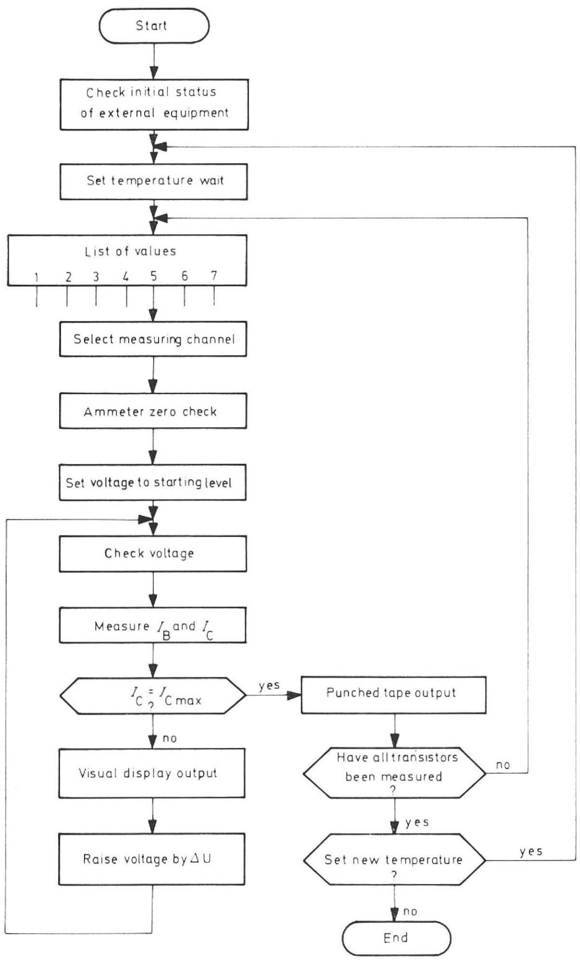


Fig. 2 Flow Diagram for the Measurement of Transistor Characteristics

- During the initial status check of the external equipment adjustment errors are indicated by a print-out, and must be corrected manually.
- The temperature of the chamber is set by a digital potentiometer which is controlled by a corresponding 9-bit pattern via a CAMAC register.
- A list of values contains unit number, parameter, maximum ratings and the measuring channel number of each transistor. The computer program adjusts the external equipment according to this list of values.
- The list permits the selection of measuring channels in a random order. The channel selector allows a maximum of 100 devices under test in the temperature chamber.
- The channel selector switch is driven by a stepping motor. The selection status is checked and an error bit is set in case of a non-valid selection.
- The voltage (UBE) is adjusted in steps, the actual voltage is checked, and the current is measured. Corresponding values, UBE, IC, IB are stored in the computer memory and are presented by line plot on a graphic display monitor. The display is given in semilogarithmic form.
- An error detected during a measuring cycle resets the equipment and an error indication is printed out.
- Maximum ratings for voltage-current generation are set under program control. If these ratings are exceeded a program interrupt stops the measuring cycle.

CONCLUSIONS

The computer controlled system described above for automatic testing of semiconductor devices was set up in a limited time, taking advantage of readily available CAMAC hardware units and software routines. A great quantity of data has been collected in a short time, and subsequent data analysis allowed reliable interpretation of irradiation effects on the devices and simplified selection criteria for the intended application. The flexibility of CAMAC as a standard modular instrumentation system proved to be very powerful for this application in laboratory automation.

ACKNOWLEDGMENT

The authors would like to thank Dr. H. Meyer, BCMN Geel for his assistance in this publication.

REFERENCE

P. Abend *et al.*, Rechnergeführte Messungen an Halbleiterbauelementen unter Anwendung des CAMAC-Systems. *Kerntechnik*, Vol. 15, (1973), No. 3, p. 128.

ESONE ANNOUNCEMENTS

ESONE COMMITTEE ANNUAL GENERAL ASSEMBLY

The Executive Group of the ESONE Committee has decided to hold an ESONE Committee Annual General Assembly in the afternoon of Thursday, 6th December in Luxembourg just after the end of the Symposium. The primary objects will be to elect an ESONE Chairman for 1973/74, to review aspects of the Luxembourg Symposium and the activities of the ESONE Working Groups. The Assembly will end not later than 20.00 hours on Thursday.

If, a presentation and consideration of Working Group papers would require the duration of the Assembly to be extended, Committee Members will be notified in good time to make the necessary travel re-arrangements.

2

A REMOTE HYBRID TERMINAL FOR PATHOLOGY LABORATORIES

by

C. J. White

Department of Clinical Chemistry, Royal Infirmary, Dundee, Scotland

Received 15th February 1973

SUMMARY A single-crate CAMAC terminal, including a programmed Dataway controller and modified Teletype driver operating at 2400 bauds, interfaces laboratory instruments and Teletypes to a remote computer. It can transfer 40 hybrid commands and replies per second. Software has been written for driving the terminal from a Modular One computer.

INTRODUCTION

The laboratory terminal described in this article was designed to assist hospital pathology laboratories faced with a rapidly growing work-load.

Automatic chemical analysers have been in use in clinical chemistry departments (a branch of hospital pathology) for many years and several systems have been employed to interface them to computers in order to obtain on-line print-out of analyses.[1, 2]

The remote data-terminal approach was conceived as an attempt to integrate the hospital laboratory services with the rest of a computerised patient information system. Several laboratory terminals may be driven by one central computer which itself may be linked to other computing nodes in a hospital information network.

LABORATORY TERMINAL CONFIGURATION

The terminal employs a single CAMAC crate under the control of a Nuclear Enterprises 7025 Programmed Dataway Controller, as shown in Fig. 1. The 96-word program is contained in three 7044 Program Modules.

A starter circuit provides automatic restart when power is applied to the crate and is built into the plastic shell of a CANNON plug fitted to the external control connector of the controller.

A 7016 Driver acts as an 'external address input' for the controller and also as the subroutine return link register. Program workspace registers are provided by a 709 Quad Register.

Analog channels are selected by a series of CE601 Relay Multiplexers driven by a further 7016 Driver. Each analog channel comprises a 'signal' and 'reference' pair, so the outputs from the Multiplexers feed a pair of 7055 Analog-to-Digital Converters which operate simultaneously. Communication with the computer uses serial signals in the CCITT V24 standard. A special module was constructed to convert the data signals to the 20mA form required by the modified 7061 Teletype Interface, and to provide control signalling to satisfy the V24 standard protocol.

The remaining 11 stations can accommodate any desired mix of 9013 Input/Output registers and 7061 Teletype Interfaces. A typical hospital laboratory may require two or three teletypes associated with twenty or more analytical channels, each of which may require sampling at intervals in the range 0.1 to 10 seconds. Digital control signals may also be required to drive indicator lamps and read status switches.

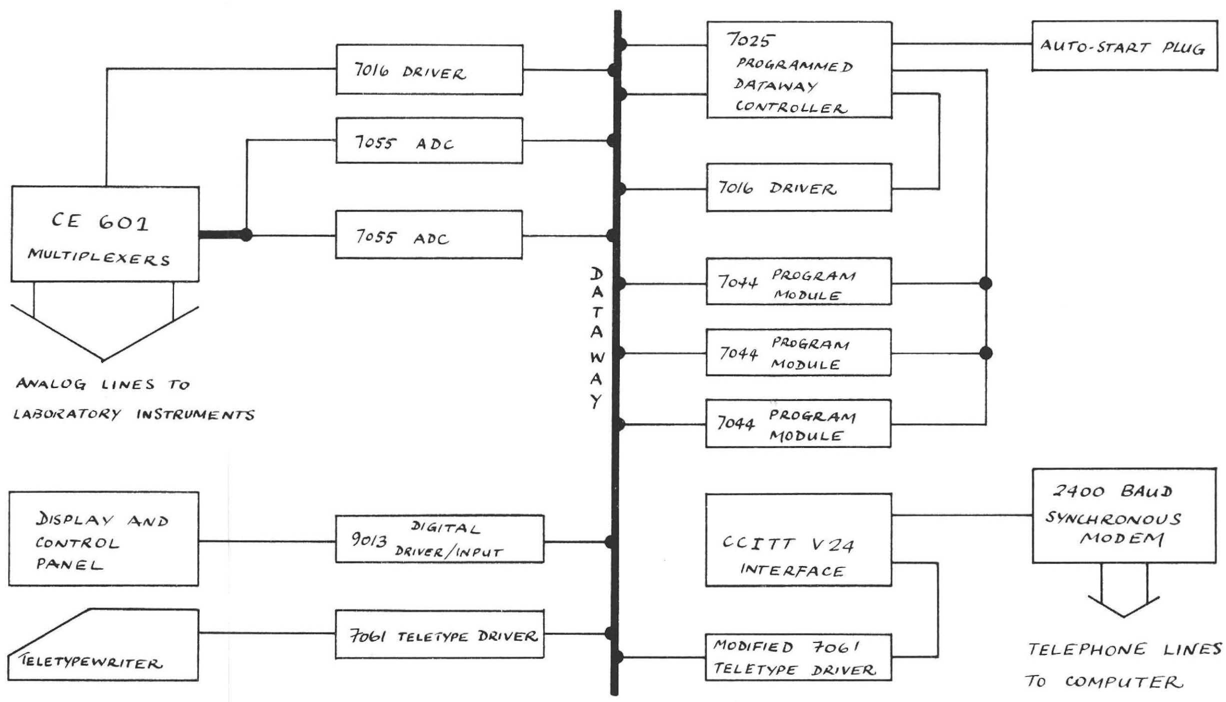


Fig. 1 Block Diagram of the Laboratory Terminal

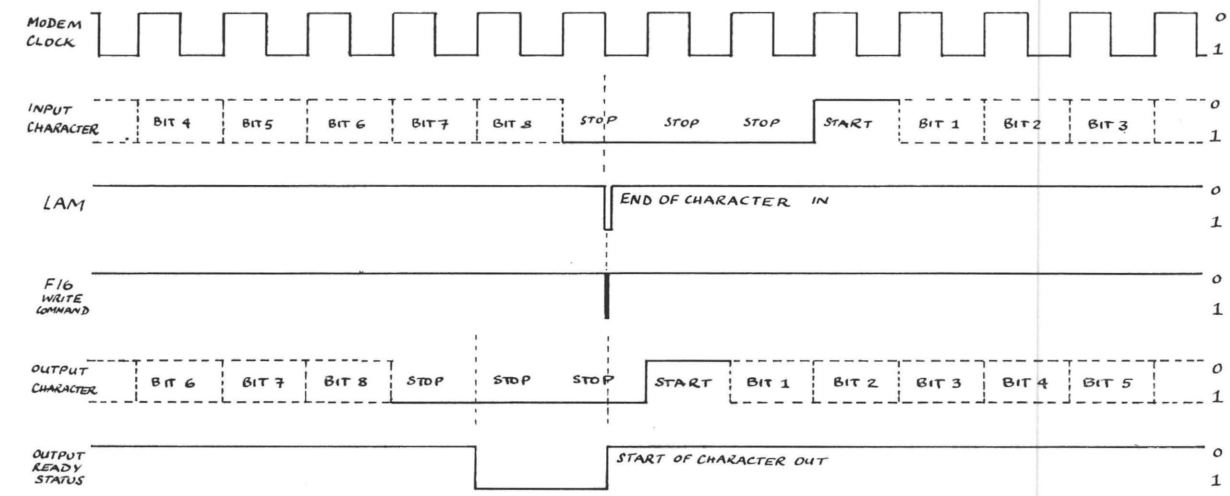


Fig. 2 Character Timing

CHARACTER TRANSMISSION

The communications system operates through synchronous modems running at 2400 bits per second.

The data-transmit clock at the computer end of the link demands a continuous stream of data-bits from the computer. These are assembled by software into 12-unit asynchronous-type characters having a start bit, 8 data bits, and 3 stop bits. The oscillator of the master 7061 is tuned to run at 2400 bits per second so that, when a character arrives, a LAM is generated coinciding with the nominal centre of the first stop bit. Receipt of this LAM causes the program to enter a subroutine which sends out an F(16) command to transmit a reply character. As can be seen from the timing diagram, Fig. 2, the 7061 transmits half a stop bit before sending the start bit, so that the input and output data streams are bit-synchronised. It is only necessary to turn around the incoming modem receive clock to become the transmit clock, and a synchronous character transmission system is obtained.

COMMAND FORMAT

Commands are transmitted to the terminal in frames of 5 characters, giving an overall rate of 40 commands per second. Each command frame specifies an analog operation and a digital operation. One character contains an 8-bit analog channel address. The command and data for the digital operation are contained in two characters, which are duplicated to provide some error-protection. The command character is split into two fields, the first 4 bits give a CAMAC Station Number, and the other 4 bits are a command-field defining a limited range of operations on a teletype interface as I/O register module, as shown in Table I.

Table I

COMMAND-FIELD DECODE TABLE

Bits 8 7 6 5	Operation
1 X X X	NO-OPERATION
0 0 X 1	READ AND ECHO 7061
0 1 X 1	WRITE DATA TO 7061
0 0 0 0	READ BITS (1-8) 9013
0 0 1 0	READ BITS (9-16) 9013
0 1 0 0	WRITE DATA TO BITS (1-8) 9013
0 1 1 0	WRITE DATA TO BITS (9-16) 9013

REPLY FORMAT

As may be seen from the program diagram, Fig. 3, the reply to a command frame is transmitted while the next command frame is being received.

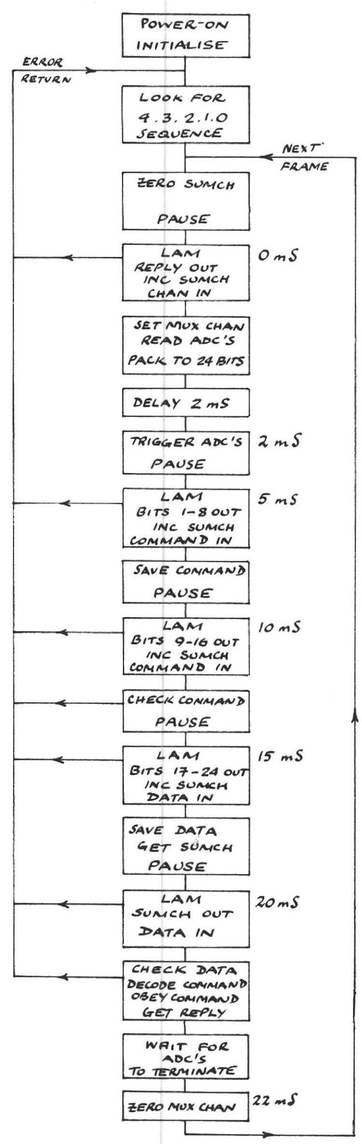


Fig. 3 CAMAC Program

The first character contains the reply to the previous digital operation. The next three characters contain the reply to the analog operation. The outputs from the two 12 − bit + sign ADC modules are compressed into 24 bits by replacing any negative values by zero. The last character contains the least significant 8 bits of the arithmetic sum of the first 4 characters to provide some error protection.

ERROR CONDITIONS AND START-UP

Errors in the command data-stream are detected for the following reasons:

(1) LAM arrives before the previous character has been output.
(2) The duplicated command-bytes are not identical.
(3) The duplicated data-bytes are not identical.
(4) The command-byte station-address is out of range.

All errors immediately switch the program to its start-up procedure, in which all received characters are turned around and sent back until the unique 5-character sequence 4, 3, 2, 1, 0, is detected.

DISCUSSION

The laboratory terminal described in this article forms part of the 'Pathlab System' marketed by Computer Technology Ltd., and permits their Modular One computer to control several laboratories. Software drives the terminal as a hybrid time-division multiplexer permetting analog sampling rates between 8 per second and one per 8 seconds. The transmission rate of 40 commands per second also permits up to 4 teletypes to be operated at full speed.

Many laboratory instruments are now being produced with some form of digital output and it would be useful to sacrifice some analog commands in favour of more flexibility in the digital commands. The terminal in its present form is too rigid and does not permit such re-configuration. However, with the use of the new 256-word store for the 7025 controller, and a V24 serial interface designed to operate in synchronous mode with 8-unit characters, it is feasible to produce a system capable of handling some 120 commands per second, each of 16 bits and fully codable at run-time. The redundancy inherent in such a system, if properly used in an interleaved, Hagelbarger-[3] type error-detection scheme could give a level of protection several orders of magnitude better than that possible with the present structure. It would also be possible to arrange that critical commands would have to be duplicated before being obeyed, to give a very high degree of security when driving sensitive or costly equipment.

ACKNOWLEDGEMENTS

The laboratory automation project of which the terminal forms an integral part is supported jointly by the Scottish Home and Health Department, the University of Dundee, and Computer Technology Limited of Hemel Hempstead, England.

I am indebted to Professor E. G. Cullwick, Department of Electrical Engineering and Electronics, and to Professor P. D. Griffiths, Department of Clinical Chemistry, both of Dundee University, for their continued encouragement and support. Thanks are also due to my colleague, Mr. N. W. Carter, who wrote most of the software and to Mr. D. Miller of Computer Technology Limited, who built the prototype V24 interface and 7025 starter plug.

REFERENCES

1. M.A. Blaivas and A.H. Mencz, Technicon Symposium on Automation in Analytical Chemistry, Vol. 1, 1966, p. 368.
2. On-line Acquisition of the Output of Auto Analyzers, P. D. Griffiths and N. W. Carter, *J. Clin. Path.*, Vol. 22, 1969, pp. 609-616.
3. W. W. Peterson, Error-Correcting Codes. Chapter 12, Recurrent Codes. MIT PRESS 1961.

NEWS

PROPOSAL FOR A PROGRAMMING LANGUAGE

A group from several German laboratories, computer manufacturers and software houses has designed a programming language for real time applications. The description 'PEARL, a proposal for a process- and experiment automation realtime language' KFK-PDV-1, April 1973, is available from Gesellschaft für Kernforschung, D-75 Karlsruhe, Postfach 3640. PEARL will be able to handle all sorts of peripherals including CAMAC.

In contrast to the CAMAC language* and the CAMAC IML, which have to be embedded into a host language for the processing of information, PEARL is a complete language itself, working in conjunction with a suitable operating system. PEARL includes a system description part for describing the I/O-structure and for naming peripheral devices and interrupt signals, task management and synchronisation, provides for standard-, graphic- and process-I/O and has arithmetic facilities with many different data types, e.g. bit-, string-, format- and duration-variables.

* See Supplement to *CAMAC Bulletin* No. 5.

3

MEDAC-CAMAC
A CAMAC SYSTEM FOR MEDICAL DATA ACQUISITION AND CONTROL

by

William K. B. Sie* and John N. T. Potvin
Division of Medical Computing, University of Toronto, Ontario, Canada

Received 5th February 1973

SUMMARY A CAMAC system connects real-time and on-line medical experiments in remote laboratories to a Sigma-5 computer. In addition to a normal Branch Highway there is a 2-phase Branch Highway for distant crates. The system is enhanced by mini-computers used as local high-speed autonomous controllers and buffers.

INTRODUCTION

The MEDAC system described here was developed to provide a data acquisition and control facility to medical researchers at the University of Toronto. The development of the system started about 2½ years ago. Over this period the system has gone through various phases of development before it took on its present shape. The sophistication and the variety of research conducted have required a supporting system with a high degree of computing power. Yet the system should be as simple as possible to operate, economical, and as flexible as possible to handle future needs. An obvious decision has been taken to use CAMAC crates for the front end. A Sigma-5 computer hosts a modified Xerox RBM system with 128 Kbyte core memory, 6 Mbyte RAD (Disc), and various other peripherals to provide the computing power necessary to drive the CAMAC system.

The hardware is supported by powerful MEDAC-CAMAC system software built on top of the RBM monitor. Through the use of centrally created utility subroutines, the researcher can quickly generate a Fortran program that will control the experiment and the acquisition of analogue and digital data in his laboratory. Interaction between the researcher and the Sigma-5 is accomplished by the use of teletypes or keyboards connected to the Character Oriented Communication equipment (COC) of the Sigma-5. In addition to the Real-Time features to allow multi-programming in foreground, the system provides a background batch processing facility.

GENERAL DESCRIPTION

Fig. 1 shows the block diagram of the system. A Branch Highway Driver (BHD) drives the normal Branch Highway (BH). The BH differs from, and predates, the CAMAC Branch Highway defined in EUR 4600. The BHD is connected to the Direct Word I/O and Priority Interrupt of the Sigma-5. This allows the CPU to control experiments in a real-time environment and respond accordingly.

The BHD is designed to communicate with Direct Word I/O signals. However, if necessary an adapter may be used to allow the BHD to communicate with a channel. 32 data lines are provided by the Direct Word I/O but only 16 data lines are used for CAMAC transfer. The Direct Word I/O supplies 16 address lines which are used to specify Crate Address, Station Number (N), Sub-Address (A) and the first 4 bits of the Function (F) for a CAMAC operation. The Sigma-5 Read or Write Direct (RWD) line specifies F16.

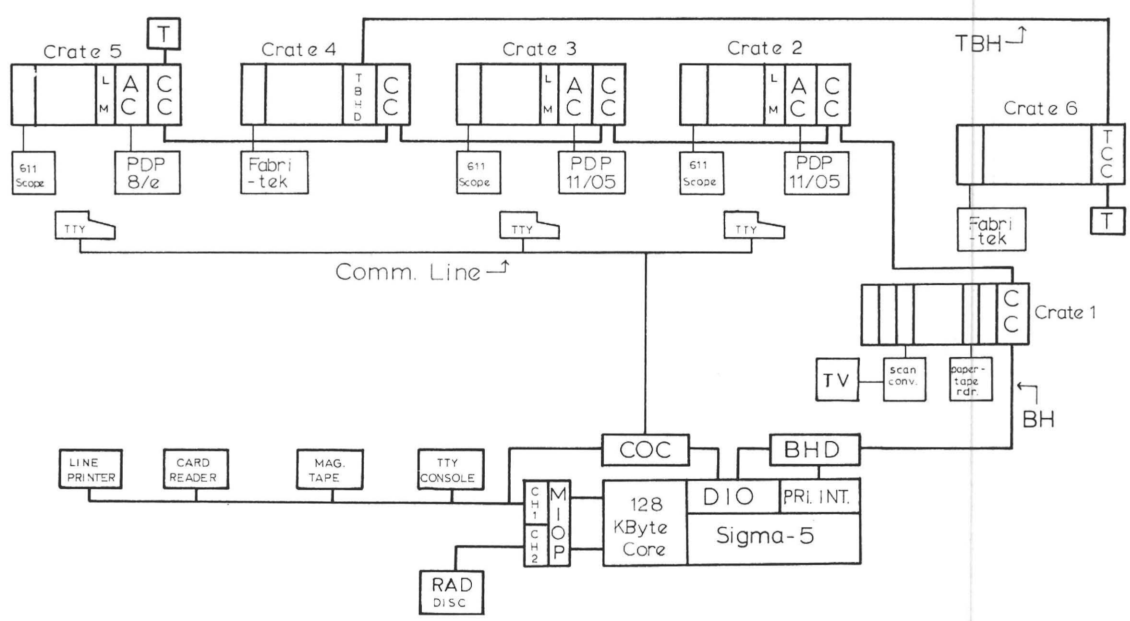


Fig. 1 MEDAC-CAMAC System

* Now with P. T. Winiharto, Jakarta, Indonesia.

To provide an economical and reliable way of connecting crates with distances over 1,000 feet, a 2 phase Branch Highway (TBH) system has been designed. This consists of only one 19-pair cable, in comparison to two 18-pair cables used in the normal Branch Highway (BH).

To improve the real-time performance of the system, a local mini-computer such as PDP-11 or PDP-8 is used in laboratories requiring high speed data acquisition. The local PDP-11 or PDP-8 controls the modules in the laboratory crate through an Autonomous Controller (AC).

The communication between the Autonomous Controller (AC) and the normal Branch Highway Crate Controller (CC), and hence the communication between the local mini-computer and the Sigma-5, is performed through the use of a Link Module (LM). The Link Module (LM) is like any other CAMAC module and can be addressed by either the AC or the CC. The Sigma-5 can write data into the LM which is then read by the local mini-computer. Similarly, the local mini-computer can send data to the LM which forwards the data further to the Sigma-5.

NORMAL BRANCH HIGHWAY (BH)

As explained earlier, the Normal Branch Highway (BH) is driven by a Branch Highway Driver (BHD) that is connected to the Direct Word I/O of the Sigma-5. The signals on the BH are TTL level signals. The BH consists of two Belden Cables. Each cable consists of 19 pairs (18 are used) of individually twisted and shielded wires. The CAMAC crates are connected onto the BH in a daisy-chain configuration.

A 3-bit Crate Address register in the Branch Highway Driver (BHD) specifies the address of a crate. All CAMAC operations are preceded by a Crate Addressing sequence to fill the Crate Address register. Since a CAMAC task or subroutine is associated with a specified crate, the Crate Address sequence is performed by the system only at the beginning of a subroutine. Thus, all CAMAC instructions after the Crate Addressing sequence will be directed to this specified crate address.

On the BH, data is transferred by 16 bidirectional data lines. Station Number (N), Sub-Address (A), and Function (F) are specified by 14 control lines derived from the address lines of the Direct Word I/O. One common interrupt line transfers the 'OR' of all LAM's to the computer. Another line carries the status (Q).

A repeater module is installed after a distance of approximately 400 feet to compensate for the IR drop on the lines. The last crate on the BH has termination resistors and is approximately 1,000 feet away from the computer.

TWO-PHASE BRANCH HIGHWAY (TBH)

The two-phase Branch Highway (TBH) utilizes differential drivers and receivers. The differential mode provides better noise immunity and is capable of driving lines longer than 1,000 feet.

A two-phase Branch Highway Driver (TBHD) resides in one of the crates on the normal Branch Highway (BH) and is connected to the daisy-chain. Currently, the normal Branch Highway Driver (BHD) addresses the TBHD as another Crate Controller (CC).

The TBHD can drive another 12 two-phase Crate Controllers (TCC's) which control modules in 12 different crates. The TBH consists of 19 individually shielded and twisted pair lines. Three lines; Branch Highway Driver Strobe (BHDS), Crate Controller Strobe (CCS) and Control (CO) lines, control the mode and the hand shake operation on the TBH. The remaining 16 lines are multi-functional lines, they are used to transfer 16-bit data as well as defining Station Number (N), Sub-Address (A) and Function (F). The same lines are used to address 12 different two-phase Crate Controllers (TCC's) and also serve as separate interrupt lines from the TCC's. The status bit (Q) is also transferred by one of these lines.

Upon recognizing its address, the TBHD can either perform a Connect operation or a CAMAC Transfer operation depending on the state of the control lines.

A Connect operation connects the selected crate and disconnects the previously connected crate. Therefore, only one crate can be connected to the TBHD at a particular time and only a connected crate can respond to a CAMAC Transfer. On a CAMAC Transfer operation the TBHD sends the Station Number (N), Sub-Address (A) and Function (F) to the connected TCC which stores them in a register and signals the TBHD for the completion of the cycle. The TBHD will then send data if it is an operation with $F16 = 1$ and $F8 = 0$, or wait for data if $F16 = 0$ and $F8 = 0$. After the CAMAC data operation has been completed, TCC will send status bit (Q) back to the TBHD. Thus, a CAMAC operation is performed in two phases, the control phase and the data phase.

AUTONOMOUS CONTROLLER (AC)

In addition to the normal Crate Controller (CC), an Autonomous Controller (AC) may be used to control modules in the same crate. The AC occupies a normal station in the crate and shares the use of the Dataway with the CC. No priority is assigned to either of the controllers, the controller that requests a CAMAC operation first gets the control for a full CAMAC cycle before passing the control on to the other controller.

Two different Autonomous Controllers have been designed to interface the Unibus of a PDP-11 and the Omnibus of a PDP-8/E to the existing CAMAC system. Using the AC, a PDP-11 or a PDP-8 can perform high speed data acquisition locally and buffer the collected data. After the time-critical part of the data acquisition program has been performed, data is transferred to the Sigma-5. In this way the researcher is able to collect high speed data independently and without imposing too much burden on the Sigma-5, but is still able to use the powerful software resources and peripherals of the Sigma-5.

MEDAC-CAMAC SYSTEM APPLICATIONS

Presently there are 5 CAMAC crates connected onto the normal Branch Highway (BH).

Crate 1 is the first crate on the BH and is located in the same room as the Sigma-5. The crate is equipped with quite a variety of modules, including ADC, DAC, Display Driver, Paper Tape Reader etc. The Display Driver module can drive either a Tektronix 4501 Scanconverter, the storage scope of a Tektronix 4002 graphic terminal or an X-Y plotter.

Analogue data from a multi-track tape or digital data from a paper tape can be analyzed by the Sigma-5. The result of the analysis can be displayed, for example, on the TV monitor by the Scanconverter or printed on the line printer. The crater is also useful for testing modules and programs.

Crate 2 is in a laboratory for research in Neurophysiology. Modules in the crate are, for example, ADC, DAC, Display Driver, Interrupt Register, Counter etc.

In addition to the Textronix 611 Storage Scope, the laboratory also has a keyboard communication line. Using the keyboard the researcher is able to enter and change parameters in an experiment. A hard-copier machine makes hard copies from the 611 Tektronix scope. The laboratory has a PDP-11/05 that controls the crate through a PDP-11 Autonomous Controller.

Crate 3 also has a PDP-11/05 and an Autonomous Controller. The system is used to control Neurophysiological experiments. As in the previous crates, this is also equipped with ADC, DAC, Display Driver, Interrupt Register and other modules including a special timing module. A Tektronix 611 is driven by the display driver. An NCR thermal printer is used for communication. Hard copies are produced by a Tektronix hard-copier machine.

Crate 4 has a different application. It is in a laboratory for research in Pharmacology. There is only one module in the crate, a PDP-8 simulator which simulates PDP-8 standard I/O signals. This drives a Fabritek unit whose interface conforms to the standards of the PDP-8 Computer I/O bus. The Fabritek unit has a 1K memory and a hard-wired program to do A-to-D conversion and signal averaging. The two phase Branch Highway Driver (TBHD) resides in this crate.

Crate 5 is the last crate on the normal BH. It is in a laboratory for research in Otolaryngology. The laboratory has a PDP-8/E connected to the crate by a PDP-8/E Autonomous Controller. Equipment in the laboratory includes a keyboard terminal and a Tektronix 611 scope.

Only one crate is presently connected to the 2 phase Branch Highway (TBH).

Crate 6 This crate is approximately 2,000 feet away from the Sigma-5. It is used for research in Bio-Chemistry. The crate has a module that interfaces a Fabritek Unit to the CAMAC system.

CONCLUSION

Large scale use of CAMAC has been made in the medical area at The University of Toronto. Progress at U. of T. indicates the need for high speed Branch Highways which can be used at distances over 200 feet. The concept of Autonomous Control in a hierarchical system is evidently needed when a large CPU and its peripherals are shared by many users.

REFERENCE

J. N. T. Potvin, MEDAC-CAMAC System Progress Report, Division of Medical Computing, University of Toronto.

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 200 WORDS OR 1/4 BULLETIN-PAGE, INCLUDING ILLUSTRATIONS.*
5. *For contributed articles, 1,200-1,600 words are preferred. THEY MUST NOT EXCEED 1,600 WORDS OR 2 BULLETIN-PAGES, INCLUDING ILLUSTRATIONS. They should be accompanied by a summary (abstract) suitable for translation into other languages. The summary must not exceed 50 words.*
6. *Contributions that exceed the above maxima will not normally be considered for publication.*
7. *Manuscripts should be typed on alternate lines on only one side of the page.*
8. *Drawings and photographs should be only included if they are essential to the text. Original ink (not pencil) drawings and semimatt prints of photographs, at least twice the final size, should be submitted. The author's name and figure number should be written, lighlty 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.*
9. *Drawings must be such that the line thickness used for alpha-numeric characters and lines should still make these legible when the drawings are reduced, typically, to single-column width.*
10. *When computer print-outs are used to illustrate the text, a good-quality original must be sent to avoid the need for typesetting.*
11. *Articles which are shortened, or adapted from, original papers should identify the original in the references.*
12. *AUTHORS MUST SUBMIT CONTRIBUTIONS BEFORE THE CLOSING DATES announced elsewhere in this Bulletin.*
13. *Reprints can be ordered at any time, but authors who are likely to require reprints in bulk should request these when submitting a contribution.*

LABORATORY REVIEWS

CAMAC IN DENMARK

by

Palle Christensen*, Per Høy-Christensen** and L. Munkøe***

* Research Establishment, Risø, Denmark. ** Niels Bohr Institute, University of Copenhagen, Denmark
*** University of Aarhus, Denmark

Received 26th January 1973

SUMMARY The CAMAC activities in four Danish institutes are described.

INTRODUCTION

At present CAMAC is used in four institutes in Denmark. The first CAMAC equipment in Denmark was built in the Niels Bohr Institute in 1969; this system has several devices connected to a central computer. The University of Aarhus has one data acquisition system without a computer, and Risø has 4 dedicated systems with and without computers. The Royal Veterinary and Agricultural University has planned a CAMAC system with a computer.

NIELS BOHR INSTITUTE, UNIVERSITY OF COPENHAGEN

In order to interface nuclear measurement equipment used at the Tandem Accelerator Lab (ADC's, pulse height analyzer memories, scalers etc.) to a large Danish-manufactured time-sharing computer ('RC 4000' with 64 k words of 24-bit corestore, 512 k drum, 2 IBM-compatible magnetic tapes, lineprinter etc.) it was decided to use a multicrate CAMAC system.

Because of the fast data flow the system could not be based entirely on normal interrupts, so data transfers to the computer are mainly by direct memory access. A special computer interface and branch driver was designed, combining the branch highway and crate controllers Type 'A' from ESONE with the sequential command generators (SCG) and a small active store from the older Harwell 7000 multicrate system.

The configuration of the equipment is as follows: The interface is designed so that up to 8 different activities can run at the same time either in sequential-list or random-access mode. An 'Entry Condition Command Generator' module (ECCG) transfers the setup commands (to enable the proper units, load the SCG store etc.) from the computer to the CAMAC system. When, for example, an ADC completes a digitization, it gives a LAM. By means of the SCG program the data are read out of the ADC, transferred to the appropriate location in the computer as a single event and may be also transferred to a buffer register waiting for other coincidence events. When this occurs they will be treated in the same way as the first ADC.

At the moment the system consists of 6 ADC interfaces, 1 analyzer input module, 1 coincidence buffer unit, 2 analyzer output interfaces, 1 'ECCG', 2 LAM graders (all these units built by NBI) 1 quad-buffer register, 2SCG, 1 plug-board and 1 16-word store (all from Nuclear Enterprises), 2 crates with Type 'A' controllers (Borer and SEN), besides the branch driver and computer interface itself (NBI). The first units were built early in 1969. Most of the present system has been in operation since mid-1972, but is still under development.

UNIVERSITY OF AARHUS, INSTITUTE OF PHYSICS

In an experimental setup for lifetime measurements in ^{239}U, data are collected from a two- dimensional position-sensitive detector. Therefore three parameters (x, y, and E) have to be handled and stored (3×256 channels).

The operation of the single-crate CAMAC system is controlled by a read-only memory and programmed Dataway controller. One coincident signals from the pulse divider are accepted by the ADC's, the controller starts to execute the instructions from the diode plug-board store. Due to a very low count-rate ($\sim$0.1 cycle), there is no need for a large-capacity store.

Data accepted by the ADC's are temporarily stored in a 16-word, 24-bit store, buffering the transfers to an interface drive for a paper-tape punch (Facit 4070) which punches out the data in groups of three (x, y, E). The crate, controller, and all modules are manufactured by Nuclear Enterprises.

CAMAC was adopted because we could set up a system by using existing modules, and have the possibility of future extension in connection with a computer.

RESEARCH ESTABLISHMENT RISØ

Triple Axis Neutron Spectrometer. The triple axis neutron spectrometer TAS6 has been in operation since the beginning of 1972. The control instrumentation for TAS6 is a single-crate CAMAC system connected to a PDP-8/E computer.

The system can set the position of up to eight axes each equipped with a step motor and an absolute encoder. In TAS6 there is control of four spectrometer axes and two potentiometers for independent magnet- and temperature regulation. The neutron counts are accumulated in 8-decade CAMAC scalers. Two Nixie displays show the contents of scalers or the position of axes. Also various on-off functions can be controlled.

Several types of CAMAC modules have been designed e.g. scaler, step motor control, encoder-decoder, display driver, and special input/output modules. The software is written in assembler language.

A new spectrometer TAS7 with identical CAMAC instrumentation is at present under construction for installation at the end of 1973.

Air-borne γ-scintillometer. The γ-scintillometer HUGIN (i) is installed in an aircraft that is used in the search for uranium. HUGIN is based on a single crate CAMAC system without a computer. It is controlled from a programmed Dataway controller and a number of program modules. Input data are γ-counts, flying altitude, and clock data. Output is on paper tape and a strip chart recorder.

5 Parameter Pulse Height Analysis System. The system is used in a fission experiment at the Reactor DR3. The system, however, is of general use for experiments with one to five parameters.

The input side of the system has 5 LABEN pulse height ADC's in NIM standard. The ADC's are connected to the system via CAMAC gates. The CAMAC system is controlled by a DEC PDP-11/O5 computer with 8k core store. An oscilloscope display is driven by a CAMAC module. IBM compatible data output takes place on a DEC TU 10 magnetic tape recorder directly connected to the computer. The system was supplied, complete with software, by Nuclear Enterprises to our specifications.

Data from a physical event is collected in list mode. The program decides whether an event is of interest. The limits on the input data are entered via teletype. Besides the data-taking in list mode the system also monitors the events by recording and displaying a spectrum of one of the parameters. The recorded data can be played back from the magnetic tape with new limits, or the magnetic tape may be carried to a larger computer for further handling.

Mobile Weather Station. The weather station is housed in a 5-ton van. It has sixty channels for recording meteorological data on IBM compatible magnetic tape. The system is not genuine CAMAC, but uses only the mechanics and some of the Dataway features of CAMAC. This is because the electronics had already been designed before our attention was drawn to CAMAC in our search for a good mechanical modular system for housing about 80 modular units.

ROYAL VETERINARY AND AGRICULTURAL UNIVERSITY, COPENHAGEN, PHYSICS LABORATORY

A CAMAC system for control of a e−γ angular correlation measurement equipment has been planned. The CAMAC system will control the position of the γ-detector and control the data acquisition. A separate multichannel analyser will analyse the γ-signals.

The system will be controlled by a DEC PDP-8/L computer and single-crate controller. These units have been delivered to the laboratory.

REFERENCE

E. Mose Christiansen and P. Skaarup, An Airborne γ-Scintillometer, *CAMAC Bulletin*, No. 6, March 1973, p. 6.

NEWS

ANNOUNCEMENTS BY CAMAC MANUFACTURERS

SAPHYMO-SRAT a étudié le problème de l'utilisation d'un châssis CAMAC (équipé uniquement d'un « Dataway ») avec une, deux ou trois tensions et un maximum ou minimum de puissance. Pour cela deux solutions s'offrent à l'utilisateur:

1° Des blocs d'équipement permettent d'avoir du :
5/6 V – 10, 15, 20, 40 A
12 V – 3, 7, 10, 15, 25 A
24 V – 2,5, 3,5, 6, 9, 15 A

Ces blocs peuvent être logés dans un rack 19″ – 4 unités – 525 mm (profondeur) avec une puissance maximale admissible de 600 watts (réf. du Rack CR4).

Dans certains cas et suivant la puissance demandée par un châssis CAMAC, le rack permet d'en alimenter deux.

2° Dans le cas où l'on dispose de place derrière le « Dataway », on peut loger soit du :
5/6 V – 5, 10 ou 20 A
12 V – 7, 10 ou 15 A
24 V – 3,5, 6 ou 9 A

BENNEY ELECTRONICS LTD., England, has now available the full range of CAMAC units in kit form:

CM 1	single-width
CM 2	double-width
–	
–	
CM X	X times-width

When ordering, suffix 'A' should be added if short side-screens are required and suffix 'B' for long side-screens.

CAMAC IN VIENNA

The *Electrotechnical Institute* (Information from Prof. Dr. R. Patzelt) has a single-crate CAMAC system connected to a PDP-11/10. It is used for analysis of transients, a.c. and d.c. measurements and for measurement and control purposes in general experiments. Other systems are planned.

At the *Physics Institute* (Information from Dr. D. Hammer) a CAMAC-system has been chosen to interface various experiments to a PDP-11/45 pro cessor. The system also uses memory segmentation under control of a RSX 11-D Real-Time Executive to protect the various task areas. Foreground-background capabilities are built in for software development. At the moment three parallel branches are planned using SAIP-Schlumberger ICP 11-A longdistance branch drivers and CAMAC units. The system design allows easy extensions up to 10 parallel or serial branches.

The system will be used mainly in data acquisition and process control for general physics rather than nuclear physics experiments. For higher level data evaluation a link to a large computer system is provided via modems. First operation is scheduled to take place at the end of 1973.

The main application areas are X-ray-spectroscopy, electro-spectroscopy, mass-spectroscopy, Moessbauer-spectroscopy, nuclear magnetic resonance, surface studies and solid state studies.

It is expected that once the system is working this will generate an increasing interest in CAMAC and many new applications will be implemented during the next few years.

DEVELOPMENT ACTIVITIES

1

A UNIVERSAL CAMAC BRANCH HIGHWAY INTERFACE FOR PDP-11

by

P. Reisser

Digital Equipment GmbH, Munich, Germany

Received 11th January 1973

SUMMARY This Branch Highway controller can make 16-bit or 24-bit data transfers between any CAMAC peripheral and the PDP-11, by program-control or DMA. For fast LAM-handling each LAM points directly to its own subroutine or starts the appropriate DMA transfer. Concurrent DMA transfers are possible between 16 modules and the computer.

The CA11-C CAMAC interface (Fig. 1) provides a Branch Highway Controller conforming to the EUR 4600 ESONE specification, and connected directly to the Unibus of the PDP-11. The Branch Highway timing is generated in the interface and is independent of the Unibus timing. Data is transferred via the data buffer (16 bits) and the high byte register (8 bits), and requires one branch cycle and either one bus cycle (for 16 bits) or two bus cycles (for 24 bits).

The Crate Address and Function code are specified by two CF-registers, one for program transfers and one for DMA transfers. The Station Number and Subaddress are decoded from 9 bits of the Unibus address lines to minimize programming effort since each CAMAC register can be addressed as any PDP-11 register once C and F are specified (program transfer only). For DMA transfer the NA-register is used.

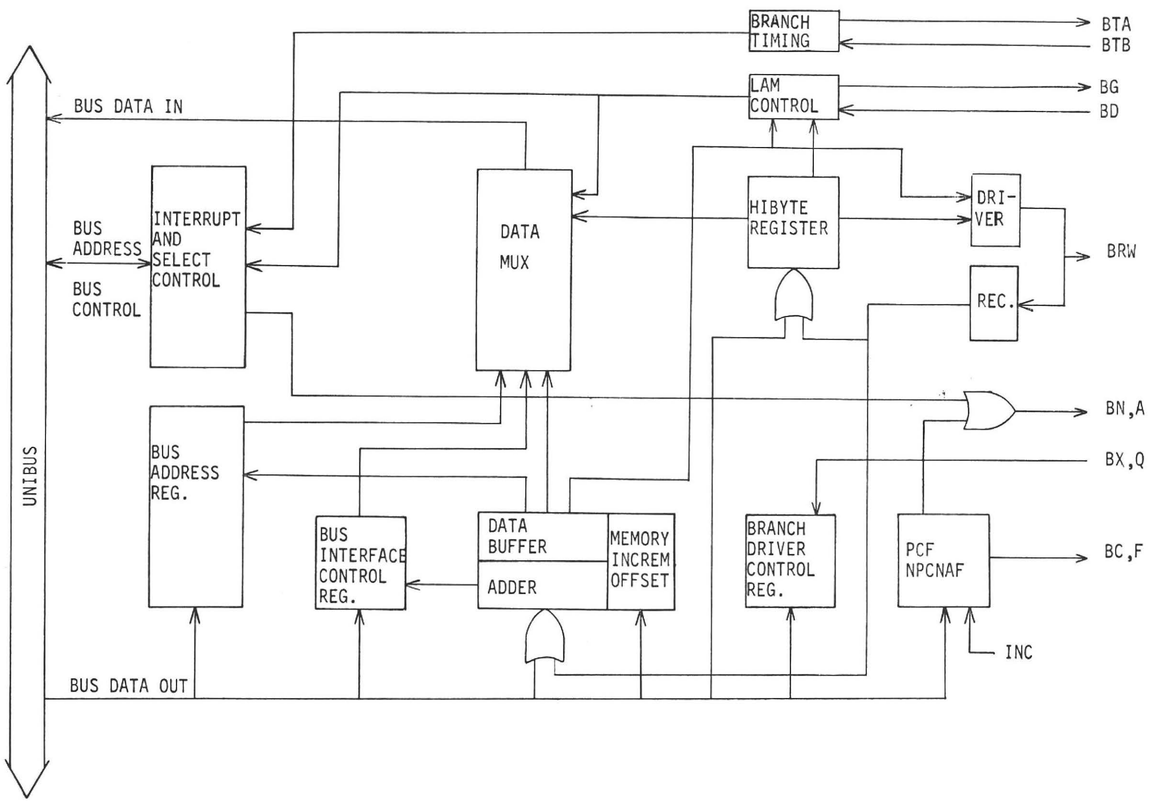


Fig. 1 Block Diagram of the CA11-C CAMAC Interface

Fast LAM-handling is achieved by an automatic Graded L Request and the specific vector addressing to the PDP-11. On receipt of a Branch Demand the interface starts a Graded L Request. The resultant 24-bit word is read into the data buffer and the high byte register. The most significant bit set in the Graded-L word is detected within 300ns and the coded value set in a 5-bit LAM register. If the LAM does not start a DMA transfer, the corresponding vector address is selected. An Interrupt Request is made to the PDP-11 in the normal way using the selected vector address. As each LAM in the Graded L word has its own vector address, the program traps directly to the required sub-routine. LAMs can be selected by patch links in the interface to start DMA transfers. If the appropriate mode is enabled these LAMs do not make an interrupt request but a DMA transfer is started immediately.

Up to 8 LAMs can be selected to start a memory increment DMA operation. When the LAMs are not simultaneous this mode is preceded by loading the CFA register with the information needed to address the data source in the crate. (The N-register is loaded with the LAM code.)

On receipt of a LAM which is selected to start a memory increment operation a branch cycle is performed, loading data from an ADC to the memory increment address register via a 16-bit adder where the address offset is performed. Two computer cycles are necessary to fetch the contents of the core location to the interface, add one and restore the incremented value. The memory increment address points to the appropriate core location. If the adder overflows to zero during the fetch cycle, an interrupt is requested.

To enable the CAMAC user to have simultaneous DMA operations, the INFO-cycle feature is provided. An INFO-cycle is used to load the necessary CNAF and MI-offset information into the appropriate interface registers before the branch cycle is started. No program action is necessary between different DMA transfers.

Several ADCs can operate simultaneously in memory increment mode. If an appropriate LAM is detected the interface registers are loaded with the necessary data source address and special offset using an additional data-fetch cycle (INFO-cycle) before a branch cycle is started. Depending on the LAM value, the interface points to a core location which holds the chosen offset and the necessary information to address the right ADC. This INFO-cycle feature provides offset variation in 400_8 word blocks. Again, 8 LAMs can be selected to start a list mode (read or write) DMA operation (also simultaneously with MI operations). In this mode the LAM value is loaded in the N-register and also used to point to an INFO core location whose content is used to load the CAF register. A special bit can be added to data in read transfers to specify the different data sources. A word count and a current address register specify list length and core block size. 16- or 24-bit words can be transferred in both directions. On word count overflow an interrupt is requested.

To transfer data between a large number of CAMAC modules and the PDP-11 two scanning modes are provided; sequential and random scanning mode a starting CAMAC register address is defined and A, N and C are scanned sequentially, by checking the Q-line and jumping to the next Station Number on negative Q-response. The sub-block counter overflow defines the end of the scan.

In the random scanning mode, INFO-cycles are use to fetch the necessary CAMAC addressing information between the data transfer cycles. The mode is initiated by a selected LAM, the LAM value is loaded into the INFO address counter, which points to the INFO core location. One bus cycle loads the contents of that location into the interface CNAF register and a branch cycle is started, then the INFO address counter is incremented to fetch the next CNAF information and so on until END information is detected.

Two modes of inter-CAMAC activity are provided in the interface. The first mode enables the user to transfer data from one CAMAC register via the interface to another CAMAC register after an appropriate LAM without program intervention (only two INFO-cycles are necessary). In the second mode a specified function can be executed in one CAMAC module after a selected LAM is detected by the interface, without program intervention (one INFO-cycle is necessary).

NEWS

ANNOUNCEMENTS BY CAMAC MANUFACTURERS

GEC-ELLIOTT-PROCESS AUTOMATION have expanded their 'System Crate' method of computer interfacing considerably during the last two years (see also: this issue, p. 21).

System Crate Interfacing for the DEC PDP-11 and DGC Nova/Supernova computer has been available for some time and has been supplied to organisations in several countries. Through the company's development programme, and joint developments with customer organisations interfaces for the following computers have been added:

1. GEC 2050 and 4080 machines. This new range of computers has been developed by GEC-Computers Ltd., and the existence of the interface will enable GEC to offer complete systems comprising computer, interface, modules and crates etc. Full software support is being developed.
2. Interdata 70 (directly or indirectly compatible with other machines in this range). Currently for program control and autonomous interrupt handling only, although a multichannel DMA facility is planned: this interface was developed in collaboration with the Astronomy Department of Imperial College, London.
3. Honeywell DDP 316/516 series. Developed in conjunction with Daresbury Nuclear Physics Laboratory (SRC), this interface incorporates several years experience gained at DNPL with CAMAC systems based on this computer series.

Further developments are underway, not only in the area of computer interfaces, but for the addition of microprogrammable autonomous controllers, and multi-channel DMA interfaces.

EMIHUS MICROCOMPONENTS LTD. have taken over the connector interests of SABCA, as from 15th March 1973. Inquiries of customers in Europe* and in all other areas should be directed to the address given below:

EMIHUS MICROCOMPONENTS LTD.,
Passage International, 29,
B-1000 BRUXELLES. Tel. 02/17.91.72

The company has taken all necessary steps to maintain product quality and to avoid any customer embarrassment by this transfer; for example, the existing SABCA stock, production tools, moulds have been absorbed and the firms retained who supplied SABCA. Thereby all items previously ordered or available from SABCA will now be delivered or supplied by EMIHUS Microcomponents Ltd.

* U. K. customers should contact EMIHUS in England directly.

EG & G/ORTEC, USA is now manufacturing in the USA 20 varieties of SEN CAMAC units, including the Display System and the NOVA Dedicated Crate Controller, in addition to their own existing range of CAMAC equipment.

2

AN EFFICIENT CAMAC SINGLE-CRATE CONTROLLER FOR PDP-8/E

by

G. Hellmann and J. G. Ottes

Labor für Elektronik und Messtechnik, Kernforschungszentrum Karlsruhe, Germany

Received 21st November 1972

SUMMARY This crate controller interfaces the 24-bit CAMAC Dataway to the Omnibus of a PDP-8/E computer. It allows single-word programmed transfers, block transfers, and LAM handling with built-in priority and fast access to subroutines. There is one-cycle direct memory access with 'Add one to memory' and 'Add to memory' sub-modes.

GENERAL

This single-crate controller is a triple-width CAMAC unit which does not use a Branch Highway port but makes direct contact to the Omnibus of the PDP-8/E. It is a two-address device following as closely as possible the recommendations about crate controllers in EUR 4600. The cable length between the controller and the Omnibus should not exceed 2 m.

PROGRAMMED TRANSFERS

The controller is able to handle different types of programmed transfers:

- Commands to the controller itself with or without data (dialogue transfers). Multi-station addressing is possible (see List of Commands).
- Commands to a CAMAC module with or without data.
- Auto-Increment N, A mode following the rules proposed in EUR 4100 (1972) as 'Address Scan'. The end-of-block condition is detected whenever the station number N (23) is generated in this mode.

Dialogue transfers are executed at computer speed. If a Dataway cycle is to be performed, the computer timing is halted for sufficiently long to ensure a safe operation, thus simulating the handshake timing system of the Branch Highway. Execution times for dialogue and system operations can be seen from Table 1. Read and write information is temporarily held in 24-bit buffer registers. The main parts of the controller are shown in the block diagram, Fig. 1.

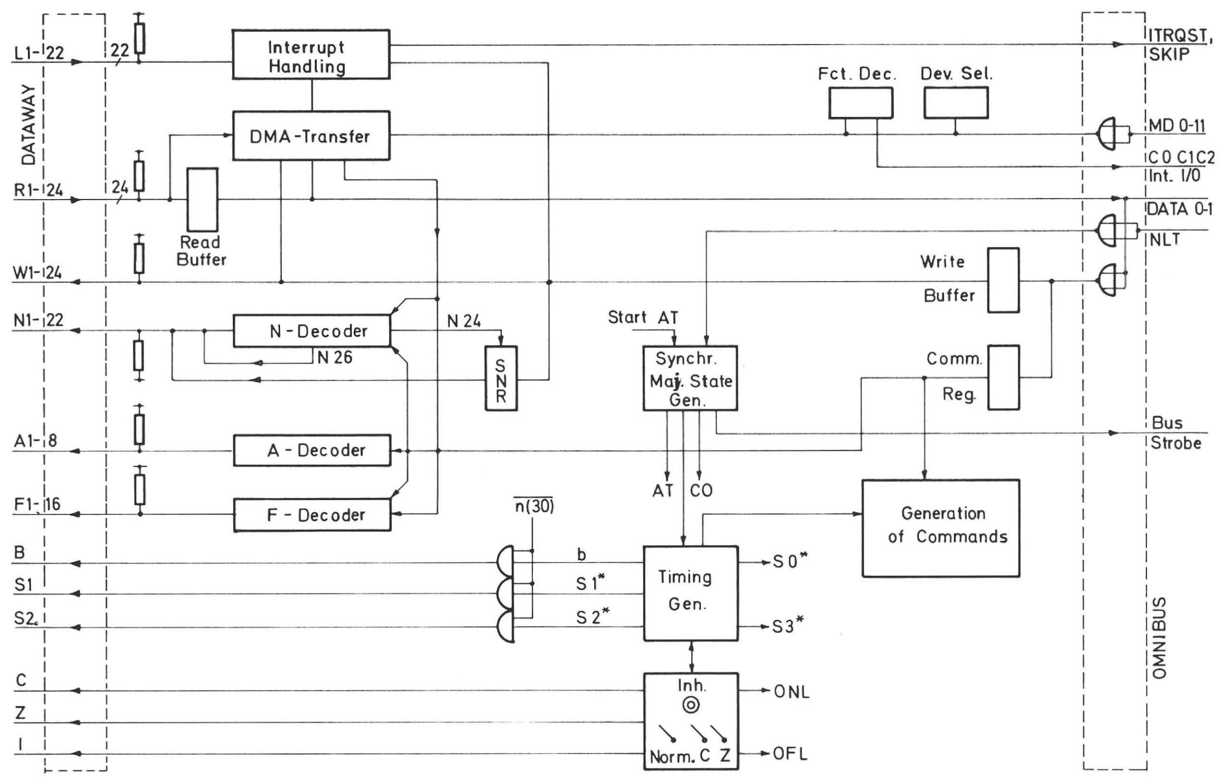


*Fig. 1 Block Diagram of Single-Crate Controller for PDP-8/E (SCC-8/E)**

* The controller will be commercially available by June 1973 from Ingenieur-Büro Eisenmann, D-7501 Blankenloch/Büchig, Vogesenstr. 6, Germany.

Table 1

TIMES FOR OPERATIONS

Operation		Addressing: Direct	Addressing: Indirect
		μs	μs
Dialogue	Dataless	8.4	11.4
	With Data	16.8	22.8
System	Data less	8.6	11.6
	With Data	17.0	23.0

AUTONOMOUS TRANSFERS

One autonomous data channel is provided for handling fast single-cycle data-break transfers. To activate the channel the appropriate L Signal is connected to the 'Break Request' input of the PDP-8/E interface. The data channel can be operated in various modes:

. Normal data transfers to and from controller-specified core memory addresses. In this mode a 'Break Memory Address Register' (BKMA) can be preloaded with the memory address. This address can be incremented after each transfer, thereby giving the possibility of shifting blocks of data into or out of the computer. The end of block is signalled by the overflow of a word counter in the controller. The overflow is converted to an echo interrupt. (L 24).

. 'Add Data to Memory'. Incoming data and data already in memory at the specified address are added and restored.

. 'Add One to Memory'. In nuclear physics this mode is of outstanding importance, for it enables the computer to act as pulse height analyser. Incoming data is transferred to the BKMA-Register and a 1 is placed on data line 11. This increments the addressed memory cell. In this mode a word capacity of 12 bits is not sufficient. By using the overflow line (OVFL) of the Omnibus it has been extended to 24 bits.

In the DMA-channel a command register and a 12-bit input and output buffer are provided, thus

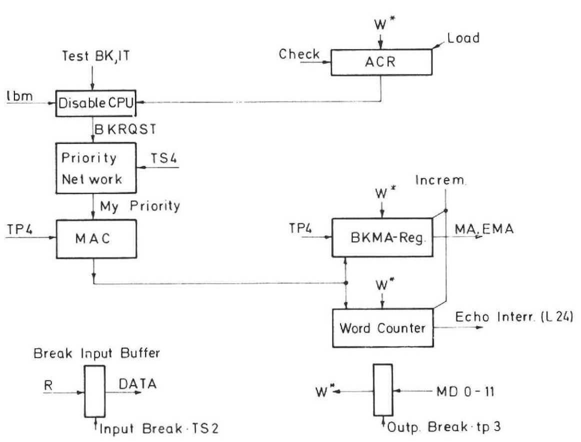


Fig. 2 Block Diagram DMA-Hardware

permitting interleaved programmed and DMA-transfers (see Fig. 2).

LAM-HANDLING

The controller processes 24 L Signals, 22 originating in CAMAC modules, L23 indicating 'End of Block' for the Address Scan Mode, L24 the same for DMA-transfers. All L signals can be masked individually. The masked LAM's are stored in a separate register which can be accessed by the computer for further analysis. In general this method of LAM-processing is rather time consuming with this computer. Therefore an alternative has been provided. It consists of a priority network connected to the LAM register. On receipt of a special IOT it performs the function: Data + contents of program counter→ program counter. One IOT is thus sufficient to take the program to the appropriate address, at which a jump-instruction to the interrupt service routine is stored.

COMMANDS IMPLEMENTED

This controller implements the commands specified in Table IX of EUR 4600e (1972) for Generate Z, Generate C, Read GL, Load SNR, Remove I, Set I, and Test I. In addition, it implements the commands listed in Table 2.

Table 2

ADDITIONAL COMMANDS IMPLEMENTED BY SCC-8/E

Action	Command			Responses	
	N	A	F	Q	X
Enable Address Scan	30	12	26	1	1
Disable Address Scan	any Command + Z + Normalize*			0	0
Overwrite Mask	28	12	16	1	1
Load Break Memory Address Register LBKMA	30	12	16	1	1
Load Word Counter LWCR	30	14	16	1	1
Clear Word Counter CWCR	30	14	11	1	1
Load Autonomous Command Register LACR	30	15	16	1	1

* Generated by push button at the front panel

REFERENCE

G. Hellmann and J. Ottes, CAMAC Single Crate Controller für den PDP-8/E Typ LEM-52/32.1. Kernforschungszentrum Karlsruhe, Bericht KFK 1719.

NEWS

PRESENTATION OF CAMAC IN DDR

At the VI Congress of the Internationale Messtechnische Konfederation (IMEKO) on June 17-23 in Dresden a paper was presented by H. Klessmann on 'CAMAC — Ein Modulares Instrumentierungssystem fuer die Rechnergestuetzte Messdatenerfassung und Prozesslenkung'. H. Klessmann is with the Hahn-Meitner Institut für Kernforschung, Berlin.

CAMAC BIBLIOGRAPHY

The Secretariat of the ESONE Committee at Ispra intends to continue the valuable work of Mrs. Tradowsky in publishing periodically a complete CAMAC Bibliography.

Further announcements on this topic will be made in the Bulletin.

3

CAMAC DATA TRANSMISSION SYSTEM FOR COMPUTER-TO-COMPUTER COMMUNICATION

by

L. Babiloni*, E. de Agostino* and B. Rispoli**

* CSN Casaccia, ** Settore Nucleare Applicata Comitato Nazionale per l'Energia Nucleare, Rome, Italy

Received 30th January 1973

SUMMARY In this data link between a central computer and remote processors the central interface is a CAMAC multiplexing system. A LAM-Grader and programmed Dataway controller organise a FIFO queue of remote-processor calls. Long distance parallel data transfers use a balanced driver-receiver module and twisted-pair lines.

INTRODUCTION

In support of the research programs of the CSN Casaccia, data Links have been developed for connecting the main computer to the small on-line computers that collect experimental data.

These links use a parallel transmission technique in order to obtain fast transfers of large quantities of data. Parallel transmission is acceptable over the distances involved between the central computer building and the experimental areas. The system uses balanced twisted transmission lines with symmetric drivers and difference-amplifier receivers. This solution was adopted in order to obtain connections of adequate length with low noise (due to common-mode rejection at the receiver input), low susceptibility to circulating ground current, and low cross-talk.

Data transfer between remote computers and the main computer is made by means of program interrupts and a handshake process. The master unit for the Data Link is the peripheral computer; that is, the operations to start the transmission or reception of data to or by central computer are initiated when requested by the peripheral compute·.

The results obtained with an experimental system indicated that it is worthwhile to link several small computers to the central computer. It was desirable to have a flexible general-purpose system that could be used with an indefinite number of remote computers. For these reasons a CAMAC solution has been investigated.

DESCRIPTION OF THE SYSTEM

The present investigation based on CAMAC was aimed at linking the main computer to an indefinite number of peripheral computers in a general way.

The Dataway concept of CAMAC appears particularly suitable for solving this problem because it consists essentially of a modular digital multiplexer, whose input channels are connected to the remote computers.

The overall organization of the system is shown in Fig. 1.

The system consists of a control unit to handle the remote computer calls, and the data Link which includes a number of identical CAMAC modules designed for long distance parallel communication.[2]

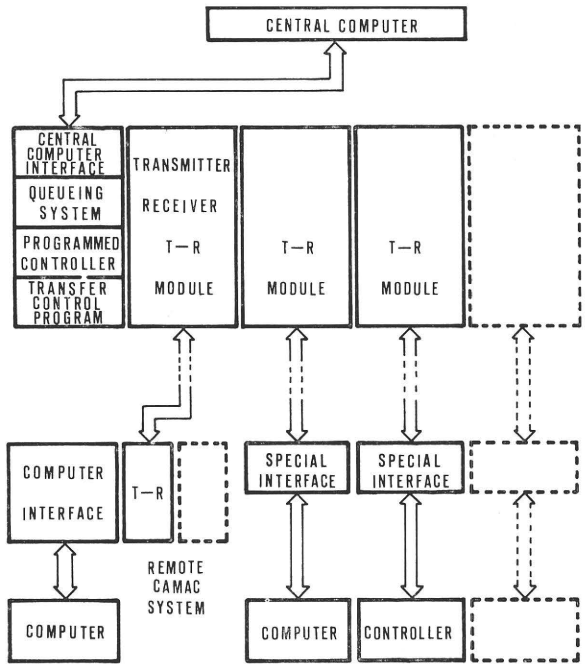


Fig. 1 Schematic of the System

The digital multiplexer control unit contains:

a) a queueing system to handle requests from remote users for access to the main computer;
b) control programs for data transfer between remote users and the central computer.

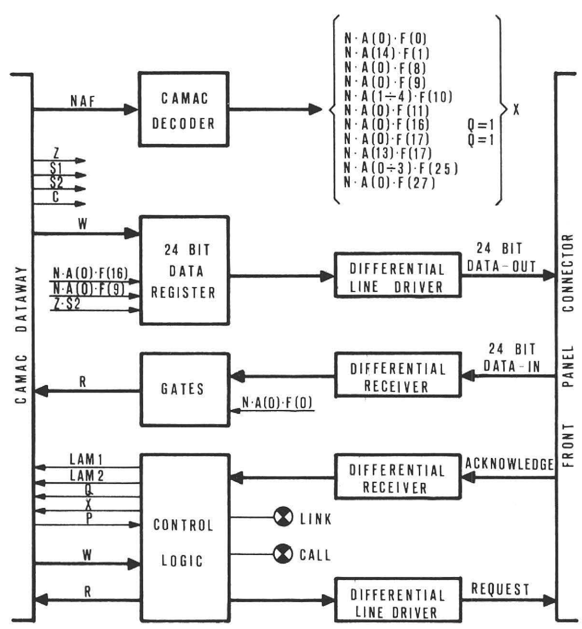


Fig. 2 Transmitter-Receiver Module Block Diagram

To implement these tasks commercial devices have been employed such as the Nuclear Enterprises 7025 programmed Dataway Controller, a local instruction store (a diode-pin plugboard) and a LAM Grader developed for this application.

The CAMAC transmitter-receiver double-width module designed for long distance parallel communication makes a bi-directional transfer of status information and 24-bit data by means of twisted pair lines (Fig. 2). The lines have a characteristic impedance of about 100Ω and for a distance of 500 m the D.C. resistance of the cable is approximately 40Ω (one conductor).

The T-R module contains essentially 24 receivers for data-input whose outputs are gated to the R lines; a 24-bit register whose inputs are gated from the W lines, 24 transmitters for data-output, and transfer control logic.

It should be noted that a T-R module generates two independent L signals. One of these calls for the Link assignment or indicates that a call has been received. The other L signal is foı all other requests originating from transfer-control LAM sources in the module.

The organization of the digital multiplexer control unit is shown in detail in Fig. 3.

The queueing system is implemented by hardware in the LAM grader. The queue is handled by means of a memory matrix operating in 'first-in, first-out' (FIFO) mode. The L signals sent from modules to the LAM grader to request the assignment of the Link are stored in the queue. Acknowledgement of this operation is sent back from the LAM grader to the calling module by an individual P Line.

The other L signals sent from modules to the LAM Grader are transmitted through an L-Mask.

Every time a T-R module is serviced the LAM grader generates the selected Station Number, the service routine address, and a Request Interrupt Signal (RIN) to the 7025 crate controller to start the program. By means of the LAM Mask, the LAM Grader permits the 7025 Controller to receive the L signal from a selected module. The L signal causes a RIN to the 7025 controller, which then continues through the program stored in the plugboard.

The data transfer between a T-R module and the central computer involves two operations: a transfer between the controller and the selected module, and a transfer between the controller and the central computer.

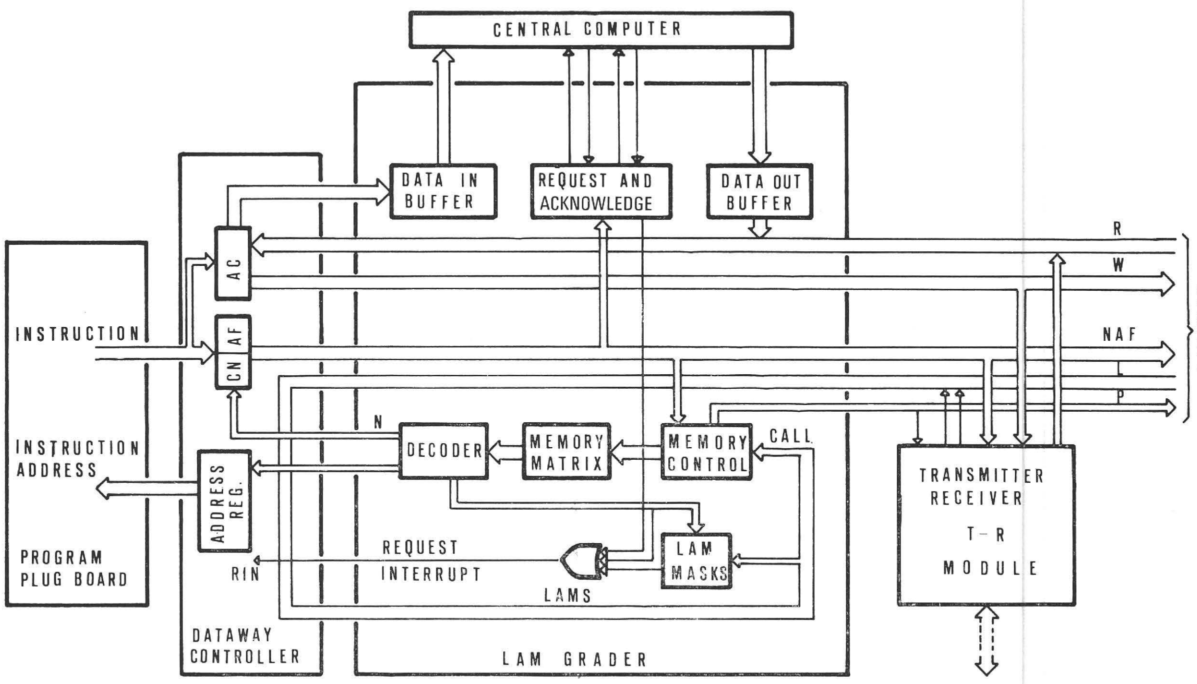


Fig. 3 Control Unit Organization

When a user informs the 7025 Controller by means of an L signal of the End of Job, the next T-R module in the queue can seize the Link.

APPLICATION

The described system has been oriented towards use with an IBM 360/44 Computer equipped with "Direct word" features.

REFERENCES

1. L. Arcipiani, L. Babiloni, E. de Agostino, A. Zampaglione, *Automazione e Strumentazione*, No. 8, August, 1971.
2. L. Babiloni, E. de Agostino, A. Ostrowicz, CNEN Technical Report RT/EL (72) 5.

4

CAMAC MODULES FOR MULTI-DETECTOR BI-PARAMETER MEASUREMENTS

by

G. Durcansky and D. Glasenapp

Institut für Festkörperforschung, Kernforschungsanlage Jülich GmbH, Jülich, Germany

Received 2nd January 1973. Revised 5th March 1973

SUMMARY Three types of CAMAC modules have been developed; an 8-channel precounter-coder, a time-of-flight clock, and a bit-handling unit. They are used, together with a computer, for time-of-flight measurements of subthermal neutrons, pulse height analysis, spectrometry, Moessbauer measurements, and sample-position-dependent neutron scattering.

INTRODUCTION

In order to build up several time of flight experiments for subthermal neutrons, three different CAMAC modules have been developed. An 8-Channel Precounter/Coder unit, a Time-of-Flight Clock and a Bit Handling Unit. This system allows measurements with up to 128 detectors and/or 4096 time channels. It is also possible to use it with a fast storage buffer for derandomizing bursts of pulses. Using the 8-Channel Precounter/Coder and a Bit Handling Unit the system is also capable of adding to the multi-detector address information on a second parameter.

DESCRIPTION OF THE SYSTEM

Fig. 1 shows the block diagram of the three modules connected in a time of flight configuration using a Time-of-Flight Clock, a Bit Handling Unit and several 8-Channel Precounter/Coders.

The 8-Channel Precounter/Coder includes a special buffer/coder with parallel-in-serial-out access, so that no loss of information occurs if simultaneous pulses reach the inputs. Optionally, by a CAMAC command, this module is also able to reduce the transfer rate to the computer by prescaling the incoming pulses (256: 1). At the end of the measurement, the contents of each prescaler may be read out by CAMAC commands.

The incoming pulses, or their prescaling overflows, are buffered in a parallel FF-Register. The numbers of the set channels are coded (3 least-significant bits), added to a preset module address (4 most-significant bits), and either read directly by the CAMAC bus or put on an external (private) bus leading to the Bit Handling Unit. When two or more channel-buffers are set simultaneously, the information is processed in a priority order corresponding to the channel number in the module. The priority between several modules is given by LAM-grading, or by the position of the modules within the external bus-system, when this is used. The 4-bit module address, which is loaded into the module by a CAMAC-command, enables up to 16 modules to be identified (i.e. 128 detector channels).

Each detector channel can be individually disabled by a CAMAC-command; all channels can be simultaneously gated by an external inhibit signal, which generally defines the beginning and the end of operation.

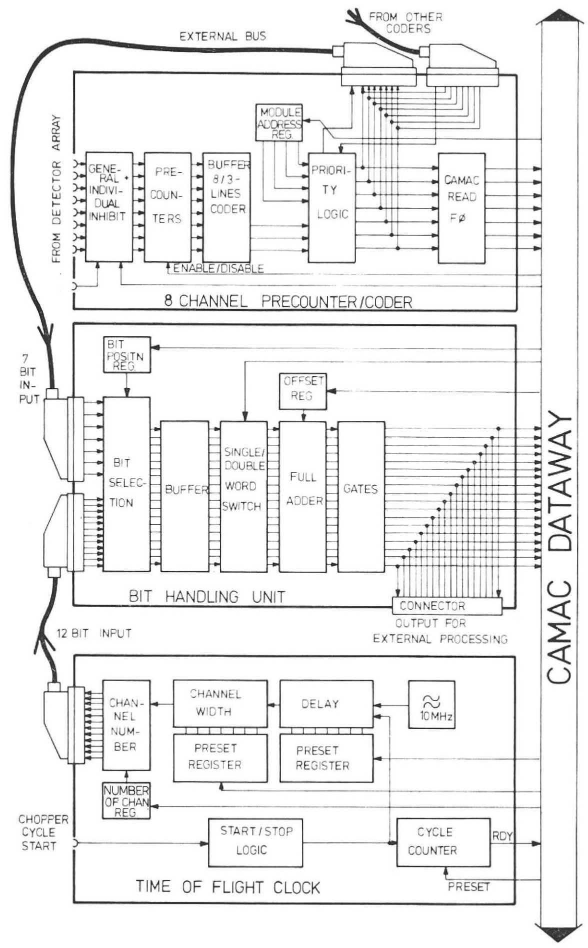


Fig. 1 Block Diagram and Interconnection of the Described CAMAC Modules (Time-of-Flight Mode)

Test pulses may be inserted selectively into every input for system checking.

The Time-of-Flight Clock is a read-out difference time clock, which provides time information after it has been started by a chopper pulse.

It consists of four counters with their associated load registers. Thus four timing values can be set by CAMAC commands:

- A delay of the chopper pulse (0 to 4 msec in steps of 1 μsec);
- The clock frequency or channel width (1 to 256 μsec in steps of 1 μsec);
- The maximum number of time channels (32 to 4096 in steps of 32);
- The number of chopper pulses to stop the measurement (1 to 2^{24} in steps of 1).

There are two inhibit outputs available. One of them is low during the whole measuring time, the second is low only when the channel scaler is counting, i.e. not while waiting for chopper pulses and during their delay time. This inhibit may gate the incoming detector pulses.

The Bit Handling Unit combines the information from several sources to form a final core memory address. A request from any Precounter/Coder causes the Bit Handling Unit to take the second parameter, e.g. the time of flight information (12-bits max.), and to combine it with the detector address (7-bits). The word-length is minimized, to match the number of detectors in use and the second parameter information. This word may be left-shifted (1 bit) to produce only even location numbers for double word precision. Finally, a constant value, the offset, is added to the biparameter word producing an absolute address.

The absolute address can be read out by a CAMAC-command or is available at an output connector, in order to be stored by a CAMAC independent interface (e.g. DMA) or to be prestored in a fast temporary buffer, for derandomizing the incoming pulses. The max. word length can be 18-bits, allowing a core memory of up to 256 K words to be addressed.

Intensive use of interlocking hand-shaking on the external bus leads to high security against faults in the system. The whole system may be tested internally by a test program that writes test pulses into the inputs of the detector units, or it may be tested externally using a suitable generator with pseudo-random sequences.

OPERATION AND PERFORMANCE

Configuration

In the multi-detector bi-parameter operating mode, every pulse from a detector (without precounters) is combined with the second parameter (e.g. time of flight) and fed to the core memory. There are several paths to the core memory as demonstrated in Fig. 2:

. Via CAMAC bus, Dataway, Crate Controller system controller, programmed data channel;
. Via CAMAC bus, Dataway, Crate Controller system controller with DMA;
. Via a CAMAC independent DMA interface.

A temporary buffer (burst derandomizer) may be inserted at the output of the Bit Handling Unit for all data paths.

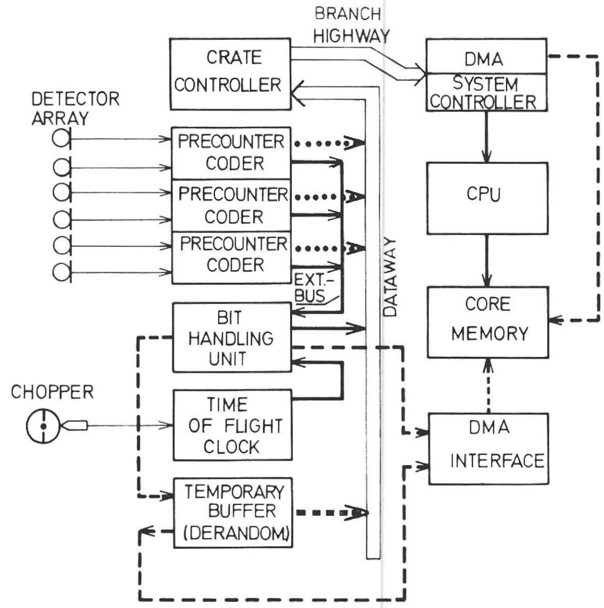


Fig. 2 Time-of-Flight Configuration with Several Possible Paths of Data Transfer into Core Memory

Performance

The processing time of pulses in the Coder and Bit Handling Unit is of the order of 400 ns. The counting rate of the system will vary between 10^2/sec and 2.10^5/sec, depending on the data path.

Applications

Besides time-of-flight measurement of subthermal neutrons there are other useful applications for these modules:

If the Time-of-Flight Clock is replaced by a coder for sample positioning, measurements in respect to sample movement can be performed. In Moessbauer measurements the actual velocity information of the driver system can be taken as a second parameter.

For simple spectrometer measurements with an array of detectors, the system can be switched to single-parameter working by giving the appropriate CAMAC commands. Here precounters are used, and the speed is thus increased to an overall counting rate of 5.10^7/s with a maximum of 128 detector channels.

ESONE ANNOUNCEMENTS

LIST OF LABORATORY PROTOTYPE UNITS

Following earlier discussions on this topic in Bulletin No. 5, readers are now invited to send to O. Ph. Nicolaysen (see address inner front cover) information on units that have been designed for domestic reasons and are unlikely to be commercially exploited by them. The Information Working Group believes that a list of these units, which can be available, free of charge, on request to Mr. Nicolaysen, could reduce duplication of design effort by putting designers in contact with each other and perhaps reveal that a 'domestic box' has wider applications elsewhere.

The listing will be helped considerably if designers supplied their information, as far as is applicable, on a standard format-sheet, CAMAC DEVICE DATA SHEET, an example of which is enclosed with this Bulletin. Any information supplied will remain the sole property of the supplier as far as the Information Working Group is concerned (see also the article on p. 31 of this Issue, 'A Standard Format for CAMAC Device Specifications).

CORRECTION TO CAMAC SPECIFICATION EUR 4600e (1972)

In the specification of the Branch Highway and CAMAC Crate Controller Type A the following minor correction should be made. This does not change the technical content of the specification.

On page 26, Section A1.4, Subsection (d) the cross-reference to EUR 4100e should read 'Sections *4.2.5* and 7.2.1 respectively'.

5

A MODULAR METHOD OF MULTIPLEXING PROGRAM SOURCES TO BRANCH DRIVERS IN CAMAC SYSTEMS

by

N. V. Toy, D. M. Drury and K. R. E. Smith

GEC-Elliott Process Automation Ltd., Leicester, England.

Received 15th February 1973

SUMMARY System Crate (or Master Crate) methods of constructing modular CAMAC system controllers have been used by a number of establishments with excellent results. A version of this approach is described. This creates a CAMAC sub-standard that may be used to construct system controllers covering a wide range of complexities.

INTRODUCTION

A System Crate method involves the use of a standard CAMAC crate to house units which use the Dataway in a non-standard manner for some portion of the operating period (re-allocation of signals only). System Crate schemes of varying design are already in use at a number of establishments. The scheme developed at Rutherford High Energy Laboratory, England, is an excellent example.[1]

An important benefit of the CAMAC modular structure is that complex requirements may readily be built up by adding together the necessary types of unit. By adopting the same sort of modularity a System Crate approach facilitates the implementation of a wide range of requirements, from simple single crate systems with only programmed transfers up to multibranch assemblies run from a number of program sources with direct memory access, even including microprogrammable autonomous controllers. There are many consequent benefits; one of the most important is simplicity of operation.

The following article describes a System Crate method which differs from previous schemes, and is now in use at a number of establishments.[2]

IMPLEMENTATION

The design aim was to develop a method of construction that would link computers and other program sources to CAMAC according to the following criteria;

- The method must be attractive to the single-crate user.
- It must be possible to expand to the maximum system size in a modular fashion such that there is no redundancy of equipment; i.e. a single-crate interface must be a sub-set of a branch driving interface, which must, in turn, be a sub-set of a multi-branch driving interface.
- It must be possible to house 'user' modules in spare stations in the System Crate whether containing a single-crate interface or a multiple-branch driving interface. Such modules must be addressed in accordance with the requirements of EUR 4100.
- The resulting interfaces must be efficient, that is, they must not unnecessarily restrict the performance of either the computer or CAMAC.
- There must be the minimum number of extra connections between the constituent units, and no pre-set parameters which depend on the position of the units in the crate.
- Boundaries: Maxima of 10 independent program sources and 4 branches were initially suggested as constraints, thus allowing up to 29-crate systems. Later developments allowed 7 branch (50-crate) systems.
- Interfaces to different computers must differ only in the design of the program sources which connect the System Crate to the computers.

The above criteria require the functions of any system controller to be divided into three well defined sections.

The section concerned with overall control is a unit sited in the control station. It controls the allocation of system cycles to program sources and the subsequent timing sequences. It also terminates the System Crate Dataway, and to a 'user' module in the System Crate it appears identical to a Type A Controller. This unit is called the Executive Controller.

The section concerned with the sequence of commands to be performed is called a Program Source. It may contain a store of commands and be able to perform limited control, or may be coupled to a computer and would therefore incorporate the data transfer stages, level translators (if required), registers to store the CAMAC command, interrupt handling features of varying complexity, etc.

The section which connects the System Crate to a branch is a unit called the Branch Coupler. It contains gates to transmit the command CNAF to the branch, bi-directional gates between the branch data lines and the System Crate, and logic to combine the various BTB replies into one reply signal. It also terminates the branch in accordance with EUR 4600.

Considerable use is made of the fact that the internal features of all the units constituting a system controller may be accessed as if they were 'user' modules.

OPERATIONAL SEQUENCE

The Executive Controller arbitrates between program sources which compete for access. It does so by means of a 4-wire Arbitration Highway cable which interconnects all program sources in the rear access area as a 'daisy chain' ending at the rear of the Executive Controller. This Highway is the only basic extra connection required between units forming a composite controller.

CAMAC Mode

To execute a command addressed to a 'user' module in the System Crate (CAMAC mode operation — see Fig. 1 for data flow paths) the program source requests access via the Arbitration Highway and on gaining access transmits the branch, crate and station information to the Executive Controller by using the Write lines in a re-allocated manner. Branch code BR (O) is used for addressing the System Crate. The A and F codes are transmitted via

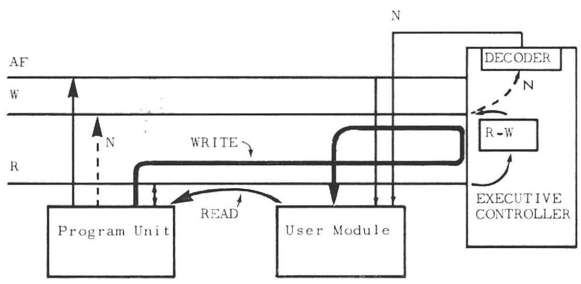


Fig.1 Data Flow Paths — CAMAC Mode Operation

the standard A and F lines. The Executive Controller detects and stores the zero branch code and the N-code, transmits Busy, and connects the Read lines to the Write lines. The program source, on detecting Busy, removes the command from the Write lines (the A and F transmissions remain), and accepts data from the user module via the Read lines directly or sends data to the module via the Read lines, the Executive Controller and the Write lines. This process requires that inputs to the program sources from the Dataway Read lines should use high-input impedance devices to avoid violating the current loading standards in EUR 4100.

The stored N-code is decoded and the appropriate 'user' module is selected by its N-line. The Executive Controller also contains a Station Number Register (SNR) which can be used as specified in EUR 4600.

The 'user' module uses the Read and Write lines in accordance with EUR 4100. The Executive Controller issues S1 and S2 at times near to the permitted minima given in EUR 4100, and the program source uses these strobes as appropriate; strobe S1 is used to accept data during Read operations, and S2 may be used to indicate the impending completion of the cycle. The cycle finishes under the control of the timing generator in the Executive Controller and the program source releases the Arbi tration Highway. There is no restriction on the placement of program sources or 'user' modules in the System Crate.

Branch Mode

To execute commands to a branch requires the addition of a Branch Coupler (double-width) which must be plugged into one of a number of specific station-pairs because of the way in which the branches are selected. 'User' modules may still be plugged into any station that a Branch Coupler is not occupying. A program source uses the Arbitration Highway in the manner described above to gain access to the System Crate and transmits the branch,

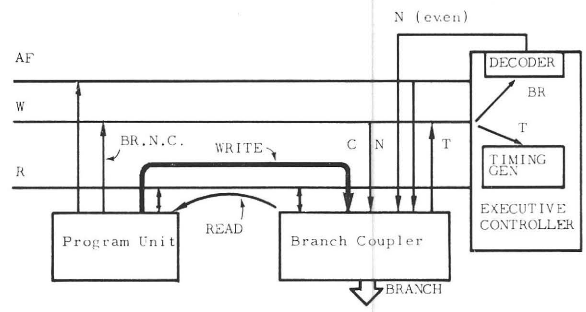


Fig. 2 Data Flow Paths — Branch Mode Operation

crate, and N-code to the Executive Controller via the Write lines.

In Branch mode operation (see Fig. 2) the Executive Controller detects and stores a non-zero branch code. The Read-to-Write gates are not opened and the Busy signal is not transmitted. Thus the program source is not forced to remove the command from the Write lines, and the Executive Controller connects the branch code to the N-decoder. The branch code is such that only N-lines of appropriate even-numbered stations can be made active. A Branch Coupler in one of these stations is thus selected by an active N-line in the presence of Busy.

The Selected Branch Coupler transmits the CNAF command to the branch by direct gating from the Write lines and A and F lines. It also opens bi-directional gates between the System Crate Read lines and the branch BR/W lines in a direction determined by the function code. The Branch Coupler uses high-input impedance devices to connect to the Read lines for the reason given above. The Branch Coupler also contains a Crate Address Register (CAR) and a Stock Register (SR).

The CAR is analogous to the SNR in the Crate Controller and may be used for multi-crate operations. The SR automatically stores the states of the seven BTB signals prior to a branch operation, and therefore identifies the on-line crates automatically.

The selected Branch Coupler issues BTA to the branch and combines various BTB replies into a single T signal, which is transmitted to the Executive Controller via a Write line. The Executive Controller modifies the timing sequence of its timing generator to introduce two waiting states; one just before S1, and the second just before S2. The first waiting state is released by the presence of the T signal on completion of the first phase of the branch cycle. The production of S1 again corresponds to the presence of stable data during Read operations and is used by the program source to accept data. The Branch Coupler removes BTA on detecting S1. The second waiting state is released on removal of the T signal at completion of the second phase of the branch cycle. The Executive Controller transmits S2 and finishes by removing the N-line signal selecting the branch, thus causing the program source to release the Arbitration Highway.

Program Sources

The advantages of modularity are extended to the construction of program sources coupling the System Crate to computers. Such units are normally divided into a section concerned with Programmed Transfers; an independent section concerned with generating Interrupt Vectors derived from automatic GL-cycles performed in response to Demands from the system; and a section concerned with Direct Memory Access for transmission of blocks of data. These sections are separate modules which are interconnected by means of a front-panel bus structure, thus removing the need for expensive internal cableforms and avoiding the problems associated with multi-board modules. Branch Couplers suitable for driving serial branches will be included in the range of equipment to extend the capability of the technique.

PERFORMANCE

An operation on a 'user' module in the System Crate takes approximately 1.6 microseconds; an operation to a near crate via a Branch Coupler takes approximately 3.1 microseconds. The times given do not include delays due to computer operation.

CONCLUSIONS

The method described provides a means of fabricating systems over a very wide range of complexities. It is a commercially — supported 'concentrated' multiplexing scheme, complementary to the 'distributed' arrangements that have been proposed (where the program sources are multiplexed onto a System Branch), and has gained impetus by easing the interface design problem.

REFERENCE

1. M. J. Cawthraw, The System Crate — A modular method of controlling CAMAC systems, Rutherford Laboratory Report No. RHEL/R246, March 1972.
2. Establishments currently using this method of assembling System Controllers include: Daresbury Nuclear Physics Laboratory; Rutherford High Energy Laboratory; TRIUMF (Canada); and Euratom (Ispra).

BULLETIN ANNOUNCEMENTS

GEOGRAPHICAL DISTRIBUTION OF CAMAC BULLETIN

Information provided recently by the Publications Office of the Commission of the European Communities indicates that approximately 4,300 copies of the *CAMAC Bulletin* No. 6 were distributed to persons interested in CAMAC in the following 37 countries:

Argentina	Finland	Norway
Australia	France	Poland
Austria	Germany	Portugal
Belgium	Greece	Roumania
Brazil	Hungary	Spain
Bulgaria	India	South Africa
Canada	Ireland	Switzerland
Chile	Israel	Sweden
Cuba	Italy	Turkey
Czechoslovakia	Japan	United Kingdom
Denmark	New Zealand	U.S.A.
Egypt	Netherlands	U.S.S.R.
		Yugoslavia

NOTICE TO AUTHORS

The organisation and preparation of texts for printing in the Bulletin is much simplified when contributing authors have closely followed the instructions given in earlier Bulletins on 'Preparation of Contributions'.

Due to the desire to improve the content, to simplify the preparation and to reduce the present rate of increase of number of Bulletin pages, *the instructions in this issue are modified on those given previously.*

Authors of articles and New Product descriptions should refer to these new instructions on page 10 before submitting texts.

PREFERRED CONTRIBUTIONS FOR FUTURE ISSUES

The Editorial Working Group believes that one of the primary aims of the Bulletin is to encourage the use of the CAMAC interface in as many of the areas of applied science as possible. Therefore in view of the need, stated elsewhere, to limit the volume of the Bulletin, the Working Group will give preference of publication to papers dealing with applications that involve the CAMAC interface and fall outside the traditional 'nuclear' area. Nevertheless, papers on any topic are most welcome and authors may care to consider submitting a summary (or abbreviated) version of a longer paper which they might be publishing in full, elsewhere.

AVAILABILITY OF CAMAC GLOSSARY

All Bulletin subscribers will receive with this Issue a copy of the Supplement to Bulletin No. 7 'A CAMAC GLOSSARY' by Mr. R. C. M. Barnes.

This glossary covers specialised technical terms used in connection with the CAMAC standards for modular data handling equipment. For each term there is an informal definition and translations of the term in French, German and Italian.

Additional copies of the Supplement can be obtained from:

Commission des Communautés Européennes,
DG XIII - CID,
29, Rue Aldringer,
Luxembourg

and the price (including postage) is 60 BFr or the equivalent in any other currency.

ACTIVITIES OF THE CAMAC WORKING GROUPS

The ESONE Committee in Europe and the USAEC 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: H. Klessmann, HMI Berlin

At its meeting in February 1973 the ESONE Dataway Working Group continued to work on the CAMAC Serial Highway, virtually excluding all other topics. The proposal from the U.S. NIM CAMAC Dataway Working Group on the Serial Highway was reviewed in detail and many improvements were suggested for a bit-serial system with a master clock in the Serial Driver, a unique message delimiter for message synchronisation, an 8-bit data field and a simple mechanism for COMMAND-REPLY operations. Moreover, the scheme for DEMAND operations, the use of delays in the Serial Crate Controllers to avoid collision of messages and the facilities for enabling and disabling demands of specific priority were clarified.

The close collaboration between the NIM and ESONE Working Groups continues also on software aspects and it is expected that the Working Groups will have agreed on the basic principals of the Serial Highway by mid-1973. A preliminary outline proposal could then be made available for further comments from members of ESONE, as well as representatives of industry.

Software Working Group

Chairman: I.N. Hooton, AERE Harwell

The attention of the Working Group has concentrated on the software implications of the Serial Highway proposals, and on the specification of the intermediate language (IML).

Comments on the Serial Highway have been transmitted to the Dataway Working Group for consideration. This work will continue with a probable emphasis on error detection and error recovery facilities.

The IML has developed rapidly through a series of drafts and this has prevented an early publication of proposals by the Working Group. The situation is now stabilising and it is apparent that IML should be defined by its semantics with recommendations on appropriate forms of syntax.

A number of different but related syntactic versions are required; for example, a listing syntax for a CAMAC language to IML translator should be totally explicit, while an IML programming syntax should include default options which ease the programmer's task.

The major task of the Working Group is to decide on the range of facilities to be incorporated in IML for operating CAMAC in a real-time environment. These facilities will include an easily implementable sub-set suitable for simple applications.

Information Working Group

Chairman: Dr. H. Meyer, BCMN, J.R.C., Euratom, Geel, Belgium

The Working Group appreciates the recent increase in the number of contributions offered for publication. However, in consequence, stricter application of the rules for preparation of contributions (see page 10) is necessary to avoid an excessive increase in Bulletin pages and, in addition, some preference may have to be given, for example, to application notes of CAMAC in new fields or to implementation of software CAMAC systems.

The availability of these types of contributions will be increased by the 1st International Symposium on 'CAMAC in Real-Time Applications', Luxembourg 4/6 December 1973. Members of the Working Group are participating in the organisation of this Symposium.

Of the 4,300 copies of Bulletin Issue 6 distributed, 1,600 were accompanied by the supplement 'Supplementary Information on CAMAC Instrumentation'. Copies of the Supplement are still available from the Distribution Office in Luxembourg at cost (see *Bulletin* Issue 6, page 12).

NIM-CAMAC WORKING GROUPS

Dataway Working Group

Chairman: F.A. Kirsten, Lawrence Berkeley Laboratory

The NIM-CAMAC Dataway Working Group is continuing to concentrate its attention on interconnection of crates via a Serial Highway. The principal business at the Dataway Working Group meeting at the National Accelerator Laboratory, April 3-4, was discussion of the draft proposal prepared by the Serial Highway sub-group. R.C.M. Barnes and I.N. Hooton, of Harwell, represented ESONE at the meetings. The sub-group, which is headed by Donald R. Machen of the Los Alamos Scientific Laboratory, met in January and again in March. K.D. Mioller of the Kernforschungsanlage Jülich represented ESONE at the March meeting. The sub-group plans to meet again in May or June in preparation for the next Working Group meeting will be in Vancouver, British Columbia in July.

Software Working Group

Chairman: S. Dhawan, Yale University

The Software Working Group met April 5-6 at the National Accelerator Laboratory in Batavia, Illinois. The Group reviewed current proposals for the Serial Highway with particular attention to those aspects effecting software, including error-message handling. The March IML draft proposal was also reviewed in detail and several modifications recommended. I.N. Hooton, Chairman of the ESONE Software Working Group, participated in the meeting.

A preliminary description of the expanded FORTRAN subroutines has been published in the CAMAC Tutorial Issue of the IEEE Transactions on Nuclear Science, April 1973.

SOFTWARE

1

AN EXTENDED BASIC LANGUAGE FOR CAMAC PROGRAMMING

by

I. Bals* and E. de Agostino

Laboratorio di Elettronica, CNEN-CSN Casaccia, Roma, Italy.
* and Institute for Atomic Physics, Bucharest, Romania.

Received 15th January 1973

SUMMARY This composite programming language consists of the BASIC high-level language with assembly language sub-routines. It is designed for use with CAMAC in conjunction with a PDP-11 computer. Four modes of block transfer have been implemented. Sub-routines for servicing interrupts from modules can be written in BASIC.

INTRODUCTION

The paper describes a composite language consisting of BASIC and assembly subroutines. It is designed to work with CAMAC hardware in connection with a PDP-11 computer, through an ELLIOTT interface.

Faced with the practical problems of using CAMAC with a minicomputer, we developed a simple language which implements most CAMAC facilities as described in EUR 4100 (1972). As we needed a quick solution, for a particular computer and interface, we did not use a general implementation-independent language which by its complexity would defeat our aims. Therefore we have written a set of subroutines for CAMAC operations in conjuction with a conventional programming language. We have chosen BASIC as host language, because it is available on the PDP-11 and has the following advantages:

. It is a conversational language (having the compiler in core) allowing the user to change parts of his program or to test any module while his experiment is running.
. It performs any arithmetic operation required for preliminary data processing.

This type of language is slow but should be trouble-free because of the small amount of data computation at this level. BASIC has no direct real-time facilities but, in the version available on the PDP-11, it has the possibility of calling an External Function (EXF) routine, written in assembly language. We used EXF as the linkage between the BASIC high level language and a routine in PAL-11 (the assembly language of the PDP-11 computer) which, together with the ELLIOTT interface, provides part of the facilities of the Virtual Controller.

It is possible to write in BASIC not only the main programs which control the experiment but also the subroutines for servicing the various module interrupts.

DESCRIPTION OF THE EXTENSION

The general form of the External Function that we have used is:

$$\text{LET U} = \text{EXF}(A_1, A_2, \ldots, A_{10})$$

where A_i are the arguments that are transmitted from the BASIC statement to the assembly routine with the following meanings:

$A_1 = T$ T:: = Type of action

where:

T = 0 for dataless operations
T = 1 for direct addressing, in read and write operations
T = 2 for indirect addressing, in read and write operations
$T \geqslant 3$ for special functions

As there is only one EXF available we use the first argument (T) to change the entry point for the various subroutines (dataless, direct and indirect addressing, interrupt handling etc.).

$A_2 = B$ B:: = Branch
$A_3 = C$ C:: = Crate
$A_4 = N$ N:: = Station Number
$A_5 = A$ A:: = Subaddress
$A_6 = F$ F:: = Function

All the arguments A_2 to A_6 are defined in EUR 4100 for CAMAC hardware.

$A_7 = L$ L:: = Length of words to be transferred between the computer memory and the CAMAC hardware:

L = 0 for CAMAC length words (24-bits)
L = 1 for computer length (16-bits)

$A_8 = M$ M:: = Operation Mode for block transfers.

We have implemented only the 4 modes which we have considered most useful in our application; the others could be implemented with more than one statement using the conditional branching possibilities of BASIC to test the BASIC variable Q.

M = 0 Repeat Mode
M = 1 Stop Mode
M = 3 Address scan
M = 2 Special Repeat Mode for successive subaddresses.

In Special Repeat Mode the program makes repeated read or write operations on the same register until the operation is successful (Q = 1), and then steps forward to the next subaddress. This mode is not presented as an example in EUR 4100 but we have introduced it for transfers between successive subaddresses and the computer memory when the interrupt technique is not suitable.

$A_9 = K$ K:: = Count

This represents the number of words to be transferred in a block transfer operation. In Stop Mode the count has no meaning so the user can give any value to K.

All these arguments (A_1 to A_9) may appear in the statment in a direct numerical form or as CAMAC names to which a number was previously assigned.

$A_{10} = V \quad V{::} = \text{Variable}$

A variable may be a number which represents the data or the computer memory location, or may be a name associated to it. The meaning of V and its defining peculiarities are related to the addressing mode and kind of transfer (read or write) as follows:

T = 1 Direct addressing

Write operations (Computer to CAMAC)
V is the numerical value of the data or the name of the data. In the latter case a number has to be assigned to the name in a previous statement.

Read operations
V is the name of the BASIC variable which will receive the value read from the CAMAC hardware; it may have been directly defined before (in an assignment BASIC statement) or defined only as an array.

T = 2 Indirect addressing

Read and Write operations
V is the numerical value of the address or the name of the computer address whose content will be involved in the transfer (from or to the CAMAC modules); in the latter case V has to be defined before, and a number which represents the physical memory location (in bytes) assigned to it.

For every data transfer operation all arguments have to be present in the EXF expression, while in dataless operations (T = 0) only the first six arguments are used.

For the special case, T = 13 (return from Interrupt subroutine), the statement contains only the first argument. For all types of operation a BASIC variable named Q will be automatically defined and given the value of the CAMAC Q response.

IMPLEMENTATION

The coupling between the computer and the CAMAC hardware is completed, as stated above, by means of an ELLIOTT Interface Suite[1] that contains various independent units. In our application we connect the PDP-11 computer UNIBUS to the Programmed Transfer Interface module PTI-11 and to the Interrupt Vector Generator module IVG-11.

The CAMAC routine in PAL-11 shown in the flow chart (Fig. 1) performs programmed operations using the PTI-11 module. The structure of this routine corresponds to the features of the module, especially with the Control and Status Register CSR and the Data Buffer High DBH register. CSR holds part of the command field; the other part is held by the address lines of the UNIBUS. DBH register contains the high order bits of the transferred CAMAC-length words.

For interrupt servicing we use the IVG-11 module which has more facilities for this kind of operations than the PTI-11 module. The IVG-11 module automatically handles the various module requests, the control being passed, according to the priority level of the request, through the vectored interrupt system of the PDP-11, to the corresponding subroutines. These subroutines (Fig. 2) have a common part, written in PAL-11, which saves the general registers

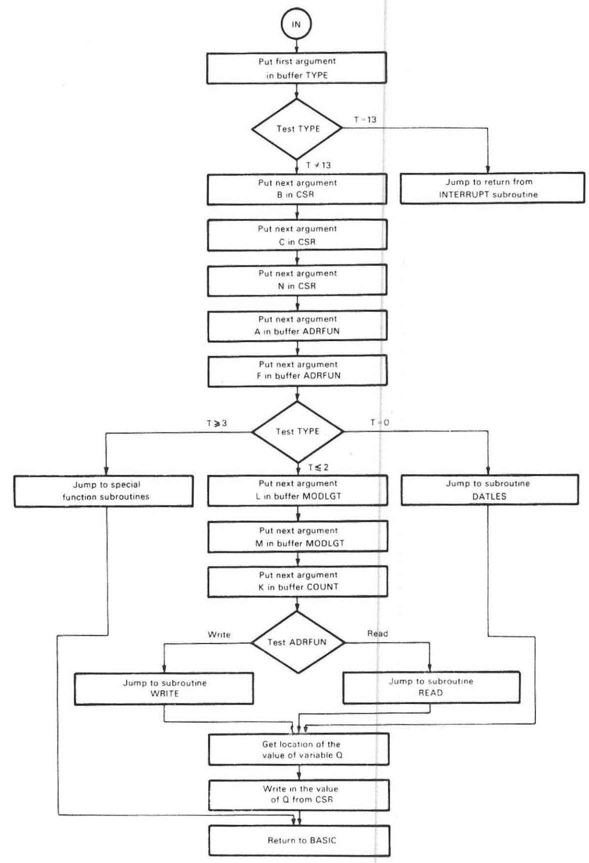


Fig. 1 CAMAC Routine (EXF)

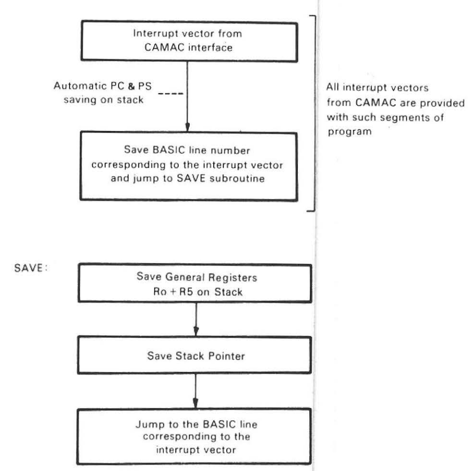


Fig. 2 PAL-11 Subroutine for Interrupt Servicing

on a stack, with the stack pointer in core, and gets the location corresponding to the first character of a subprogram written in BASIC. These BASIC subprograms are written by the user to service the requesting module. They have to begin at a fixed line (corresponding to the vector generating the interrupt) and to end with an EXF (13) which restores the general registers and then returns to the main BASIC program.

REFERENCE

N.V. Toy, D.M. Drury, and K.R.E. Smith. A Modular Method of Multiplexing Program Sources to Branch Drivers in CAMAC Systems. *CAMAC Bulletin*, No. 7 (This Issue).

2

COMP11, A CAMAC-ORIENTED MONITOR FOR THE PDP-11

by

Ronald M. Keyser

EG & G/ORTEC, Oak Ridge, Tennessee, U.S.A.

Received 9th November 1972; revised 2nd January 1973

SUMMARY COMP11, a monitor for the PDP-11, accepts and executes CAMAC-like commands from the teletype, and is written in PAL-11. For repeated execution of a set of commands, a learn or remember mode is included. The monitor automatically rejects invalid codes.

COMP11 was written to meet the definite need for a general program or monitor to allow the user to execute any CAMAC command. The design objectives were that the program should be totally general, that it should relieve the user of having to know about any computer assembly language, and that it should be able to execute a single CAMAC command and allow the user to observe the results.

COMP11, which is written in PAL-11 for the PDP-11, meets the above objectives. All the Branch Driver registers are independently accessible. The user need know only the CAMAC codes and the several mnemonics necessary to communicate with COMP11. It returns control to the user after each command is executed. The program was designed for a CAMAC system interfaced with a Branch Driver and a Type A Crate Controller.

A remember, or learn, mode is part of the program to allow for repeated execution of a series of CAMAC commands. Instructions to be learned may be entered intermixed with commands to be executed immediately.

COMP11 communicates with the user through a Teletypewriter, is a stand-alone program, and assumes only 4 k of core and no peripherals other than the Teletypewriter and Branch Driver.

In addition to the basic monitor (see Fig. 1 for flow chart), the program consists of the following subprograms (in which the terms 'assembler' and 'loader' have a special meaning):

CAMAC Function code assembler and loader;
Control status register monitor and loader;
Crate-select register and DMA word-count register loader;
Memory address register loader;
Data register loader/unloader;
On-line/Off-line (BTB lines) display routine;
Learned-subset execution routines.

The above routines accept up to three input parameters. Each routine is accessed by a two character mnemonic. The input to the basic monitor is entered as follows:

$P1/P2/P3/XX (eot),

where

$ is a preceding identifier character,
P1, P2, and P3 are input parameters (decimal),
/ is the parameter delimiter,
XX is the function mnemonic,
(eot) is the end of transmission character (Control D).

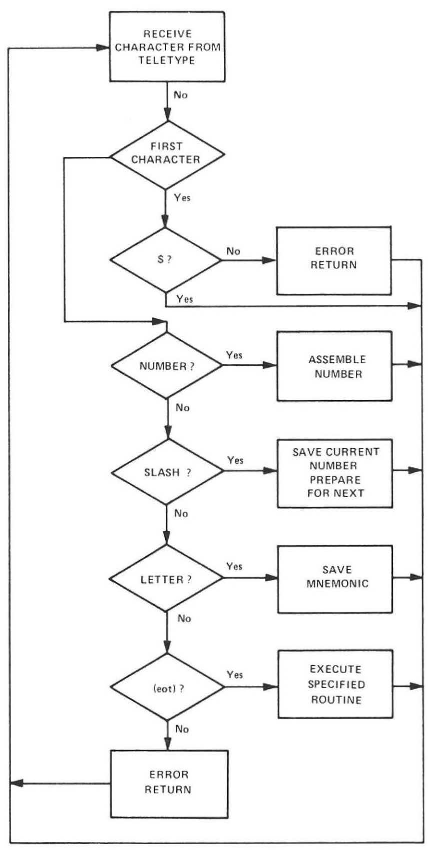


Fig. 1 Flow Chart of Basic Monitor

The preceding character, $, and trailing block character, (eot), have been added to reduce the risk of accidental CAMAC commands that could cause data to be lost. Incorrect characters are erased by means of the rubout key. An entire command may be reset by sending Control C.

The communication between the main program and the CAMAC drivers is by means of the TRAP instruction. This enables various subprograms to be assembled separately and then run with the basic monitor. The monitor program can read and punch paper tape, enabling it to perform the function of reading in a paper tape program and executing it and then reading in another program and executing it.

The CAMAC code assembler forms the CAMAC instruction, FNA, from the three input parameters and loads this instruction into the Branch Driver.

The control status monitor checks the error bits in the control status register after each CAMAC operation and prints out any errors found. It also loads the interrupt enable/disable bits in the CSR.

The crate-select/word-count loader loads the crate address lines and DMA word count register with P1 and P2 respectively.

The memory address loader checks P1 for validity; if P1 is valid, it is loaded into the DMA memory address register as the starting address for the block transfer.

The data register routine either loads P1 into the data register or prints out the contents of the data register.

The On-/Off-line routine displays which of the crates is on-line (i.e., which crate controllers return the BTB signal).

The learned-subset execution subroutine includes the list of learned functions and the ability to execute them a number of times specified from the keyboard. It can display the functions it has stored. Functions are entered into the list by replacing the (eot) with a ":" (colon). This enables learned instructions to be intermixed with immediately executed instructions.

An example of setting up the Branch Driver for reading and incrementing a scaler, which is assumed to be in Crate 1, Station 10, is shown below:

$1/0/CR	Load Crate select
$CO	Enable control status register monitor
$0/10/0/IN	Read scaler F(0), N(10), A(0)
$DP 0	Print data (scaler contained 0, underlined is reply from monitor)
$25/10/0/IN	Increment scaler
$0/10/0/IN	Read scaler
$DP 1	Print data

This easy-to-learn and easy-to-use program has been implemented on a PDP-11/20 with a BD011 Branch Driver. The test programs for standard CAMAC modules are stored on paper tape. The paper tape is read in and the test of the CAMAC modules is automatically executed. Non-standard tests are conducted via the learn mode. This program has been used successfully for more than six months in the demonstration and test of various CAMAC modules.

3

CONCO — A CAMAC LANGUAGE ASSEMBLER

by

M. P. H. Davies, P. J. Hagan and R. A. Hunt

Nuclear Physics Laboratory, University of Oxford, England.

Received 19th February 1973

SUMMARY This assembler, running on a PDP-10 computer, accepts a convenient programming language for the Nuclear Enterprises 7025 Dataway Controller, and prints-out a diode-pin layout for the controller's plug-board program-store. It enhances the viability of single crate stand-alone CAMAC systems (with Teletype) or systems coupled to the PDP-10.

INTRODUCTION

Considerable work is being done in this department on the design of a CAMAC interface to a linked PDP-10/PDP-7 configuration. Initially, however, a stand alone single crate system was set up with a Nuclear Enterprises 7025 programmable crate controller and associated plugboard memory. Communication with the CAMAC user was through a teletype and teletype interface module. There were special routines in the plugboard memory to accept and send ASCII characters.

This system was extended by developing a fast serial interface to the PDP-10, such that a PDP-10 program can transfer ASCII characters through the teletype interface module (see Fig. 1). Consequently,

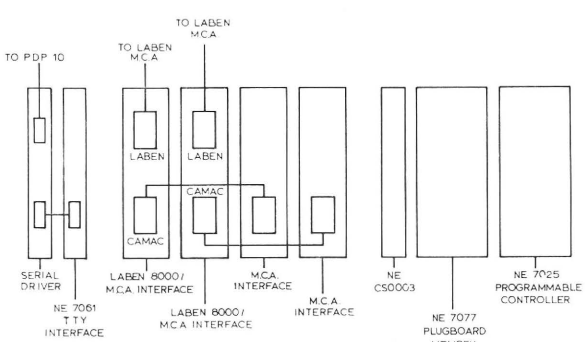


Fig. 1

the CAMAC program can communicate either with a PDP-10 program or directly with a teletype.

There were two specific problems in writing programs for this controller. Firstly, the format of the instruction codes was difficult to use and, secondly, loading a program into the plugboard memory was an art requiring much skill and concentration.

The CONCO assembler rationalizes the instruction code of the 7025 controller into a comprehensive assembler language, similar to PDP-10 Macro assembler. It performs basic error checks on the instructions, labels and arguments and provides, in its output, a bit pattern which can be used as a mask to help the plugging of diode pins into the memory (see Fig. 2).

THE HARDWARE CONFIGURATION

The standard units in this 7025 system are an N.E. 7025 programmable controller, an N.E. 7077 plugboard memory (with 64 words of 24-bits), an N.E. CS0003 16 word register and an N.E. 7061 teletype interface (see Fig. 1).

When linked to the PDP-10, a serial driver (special module) is connected to the teletype interface, which itself is modified to take a faster character rate. Eight bits of data are transferred in each character. The programs for the controller are designed to accept the high-order two bits as keys bit for control, while the remaining six bits are used for data. In this way, standard 6-bit ASCII characters can be transferred.

The 16-word register unit is used in two ways. Its primary use is for storing program parameters. However, by a front cable connection to the controller, IF can be used as read/write memory. In this mode, using a bootstrap loader in the plugboard memory, a small program can be written into the registers from either the PDP-10 or teletype. This can be very flexible when used in conjuction with fixed subroutines in the plugboard memory.

THE INSTRUCTION MNEMONICS

The CONCO assembler is written in PDP-10 Macro. It allows all the instructions of the 7025 controller to be used, most of which are data manipulation instructions. The instruction mnemonics have been rationalized to provide a clearer form. The output of the assembled CONCO program indicates the diode pin pattern for the plugboard memory.

The general CONCO format is:

⟨label⟩ : ⟨CONCO instr⟩ ⟨Args, ...⟩; (1)
eg. START : XFN MEM, A4, F17; (2)

(1) ⟨comment⟩
(2) write accumulator contents to MEM, A4 with F17.

The classes of instruction provided by CONCO are:

Immediate instructions which modify the accumulator. These allow up to 16 bits of data to be loaded directly into the accumulator. Certain logical functions can also be applied on accumulator data, such as shifting and masking.

eg: LACI ⟨16-bit data⟩; (1)
ADDIS ⟨8-bit data⟩, ⟨5-bit shift⟩; (2)
ANDI ⟨8-bit data⟩; (3)

(1) load AC with actual value
(2) add actual value to AC and shift right
(3) AND least six data bits with actual value.

Instructions involving data transfers from a CAMAC register to the accumulator. These have the general form:

⟨LABEL⟩: ⟨INSTR⟩ ⟨CAMAC ADR⟩

where ⟨CAMAC ADR⟩ can either be of the form Cc, Nn, Aa, which refers to crate c, station n, subaddress a, or ⟨SYMBOL⟩, Aa where ⟨SYMBOL⟩ is associated with the value of C and N (see section 7): The CAMAC function is assumed to be F(o).

The three basis instructions in this category are:

LAC	load AC from register
ADA	add register to AC
SBA	subtract register from AC (result in AC)

Each of these three instructions can be suffixed with certain letters to include the following conditions:

Q	skip on Q
N	skip on not Q
P	pause
S	skip
QB	skip on Q and pause
NP	skip on not Q and pause
SP	skip and pause

Instructions involving data transfers from the accumulator to a CAMAC register. The simplest of these instructions is:

STORE ⟨CAMAC ADR⟩

which writes the contents of the accumulator to the CAMAC register with function code 16. A register can also be loaded directly with

LRLC ⟨CAMAC ADR⟩; ⟨8-bit data⟩

which causes the 8 bits of data specified to be loaded into the least significant part of the CAMAC register, the most significant 16-bits being cleared.

The LRMA instruction, with the same format as LRLC, causes the 8 data bits in the instruction to be loaded into the most significant 8 bits of the CAMAC register. The remaining 16 low order bits are filled with the 16 least significant accumulator bits.

Instructions to execute a CAMAC function at a specified CAMAC address. The basic instruction is:

XFN ⟨CAMAC ADR⟩, Ff

This causes the CAMAC function f to be carried out on the CAMAC register specified, any data transfers being between the CAMAC register and the accumulator. The same suffixes can be added as in the second class of instructions (LAC, ADA, SBA) which are a subset of the XFN instruction with f=0. However, it is convenient to treat them as a separate class.

Conditional instructions. The 7025 controller provides conditional testing for a total of 9 conditions. These are the Q signal, not all data bits zero, the setting of each data bit from 1-6, and bit 24 set.

CSD ⟨CAMAC ADR⟩,⟨9 bit condition field⟩

This instruction tests the conditions requested in the condition field and if all are set then a skip is made. CSI performs a skip if the conditions are not set. There are similar instructions to perform conditional pauses and jumps.

Program control instructions. Apart from various unconditional jump instructions, the two instructions

JSR ⟨CAMAC ADR⟩. ⟨LABEL⟩
LPCJ ⟨CAMAC ADR⟩

provide subroutine calls. JSR transfers program control to ⟨LABEL⟩ and stores the value of the program counter in the register specified. LPCJ loads the program counter from the CAMAC register and continues control from there. These two instructions are very powerful in conjunction with the 16-word register module to store return addresses, and very necessary in view of the limited length of the 7025 program.

Miscellaneous instructions. The two most important of these are

EQUATE ⟨SYMBOL⟩, Cc, Nn

which, defined at the beginning of the program, associates the symbolic name ⟨SYMBOL⟩ with a particular C and N value (i.e., a single CAMAC module), and

LOC n

which establishes the relocation of the output file (see Fig. 2).

ERROR CHECKING

CONCO does substantial error checking to facilitate ease of programming. The following aspects are checked:

- Operation code validity;
- Symbolic name validity (i.e., a CAMAC name or label has been defined);
- Argument checking. This checks that data fields, CNAF field, shift fields and address fields are not exceeded;
- Too many instructions for the plugboard. Programs are severely limited by the size of the plugboard (usually 64-256 words), so CONCO checks that the maximum program length is not exceeded.

```
                                                 TITLE    SENCH - CONCO PROGRAM TO SEND CHARACTERS TO 611 SCOPE

                                                 EQUATE   SENCH,N11          ;SEN 2Ø18 CHARACTER GENERATOR
                                                 EQUATE   MEM,N1             ;NE CSØØØ3 MEMORY UNIT
                                                 EQUATE   AC,N24             ;AC OF NE 7Ø25 PROGRAM CONTROLLER
                                                 EQUATE   TTY,N4             ;NE 7Ø61-1 TTY INTERFACE

                                        ;MPH DAVIES - SEPT 72. ASCII CHARACTERS ARE READ FROM THE PDP1Ø
                                        ;& DISPLAYED ON THE 611 SCOPE, A MAXIMUM OF 32 TO ALINE.

                                                 LOC      2Ø                 ;START AT PLUGBOARD LOCATION 2Ø

2Ø    ØØØ1 ØØ ØØØØØ ØØØØ 1ØØØØ ØØ11   SCHAR:   LACI     4Ø3                ;LARGE CHARACTERS
21    Ø1ØØ ØØ Ø1Ø11 ØØØ1 1ØØØØ ØØØØ            XFN      SENCH,A1,F16       ;2Ø MICROSECONDS UNBLANKING
22    ØØØ1 ØØ ØØØØØ ØØØØ ØØØ1Ø ØØØØ   SCHAR1:  LACI     4Ø                 ;SET UP COUNT OF MAX NO OF CHS
23    Ø1ØØ ØØ ØØØØ1 ØØØ1 1ØØØØ ØØØØ            XFN      MEM,A1,F16         ;  ..
24    11ØØ ØØ ØØØØ1 1ØØØ ØØØ1Ø Ø11Ø   SCHAR2:  JSR      MEM,A8,TTYGT       ;GET AN ASCII CHAR FROM THE PDP1Ø
25    11ØØ ØØ ØØØØ1 1ØØ1 ØØØØ1 11Ø1            JSR      MEM,A9,SCHPUT      ;OUTPUT IT TO THE 611 SCOPE
26    1111 ØØ ØØØ1Ø ØØØØ ØØØØØ 11Ø1            SUBI     15                 ;WAS LAST CHAR A CR ?
27    1Ø11 ØØ 11ØØØ ØØØØ Ø1ØØØ ØØ11            JUMPE    AC,PULF            ; YES, OUTPUT A LF
3Ø    Ø1ØØ ØØ ØØØØ1 ØØØ1 ØØØØØ ØØØØ            LAC      MEM,A1             ;GET LINE COUNT
31    1111 ØØ ØØØ1Ø ØØØØ ØØØØØ ØØØ1            SUBI     1                  ;DECREMENT
32    Ø111 ØØ 11ØØØ ØØØØ Ø1ØØØ ØØØØ            SKIPE    AC                 ;= Ø ?
33    111Ø ØØ ØØØØ1 ØØØ1 1ØØØ1 Ø1ØØ            LRJ      MEM,A1,SCHAR2      ;NO, GET ANOTHER CHARACTER
34    11ØØ ØØ ØØØØØ ØØØØ ØØØ1Ø ØØØ1            JMP      PUCRLF             ;OTHERWISE FORCE A CRLF

35    Ø1ØØ ØØ Ø1Ø11 ØØØØ 1ØØØ1 ØØØØ   SCHPUT:  XFN      SENCH,AØ,F17       ;SEND OUT CH
36    Ø1ØØ ØØ Ø1Ø11 ØØØØ 11Ø11 Ø1ØØ   SCHPU1:  XFNN     SENCH,AØ,F27       ;DONE ? (Q = Ø ?)
37    11ØØ ØØ ØØØØØ ØØØØ ØØØØ1 111Ø            JMP      SCHPU1             ;NO
4Ø    11Ø1 ØØ ØØØØ1 1ØØ1 ØØØØØ ØØØØ            LPCJ     MEM,A9             ;RETURN

41    ØØØ1 ØØ ØØØØØ ØØØØ ØØØØØ 11Ø1   PUCRLF:  LACI     15                 ;OUTPUT A CR
42    11ØØ ØØ ØØØØ1 1ØØ1 ØØØØ1 11Ø1            JSR      MEM,A9,SCHPUT      ;  ..
43    ØØØ1 ØØ ØØØØØ ØØØØ ØØØØØ 1Ø1Ø   PULF:    LACI     12                 ;OUTPUT A LF
44    11ØØ ØØ ØØØØ1 1ØØ1 ØØØØ1 11Ø1            JSR      MEM,A9,SCHPUT      ;  ..
45    11ØØ ØØ ØØØØØ ØØØØ ØØØØ1 ØØ1Ø            JMP      SCHAR1             ;GO BACK & RESET LINE COUNT

46    Ø1ØØ ØØ ØØ1ØØ ØØØ1 Ø1ØØØ 1ØØØ   TTYGT:   XFNQ     TTY,A1,F8          ;WAIT FOR CHAR
47    111Ø ØØ ØØØØ1 1ØØØ ØØØ1Ø Ø11Ø            LAJ      MEM,A8,TTYGT       ;  ..
5Ø    Ø1ØØ ØØ ØØ1ØØ ØØØ1 ØØØØØ ØØØØ            LAC      TTY,A1             ;READ CHAR INTO ACC
51    11Ø1 ØØ ØØØØ1 1ØØØ ØØØØØ ØØØØ            LPCJ     MEM,A8             ;RETURN

                                                 END                         ;END OF PROGRAM SENCH
```

Fig. 2

OUTPUT FORMAT

The output of the CONCO assembler is in the form of a line printer listing (see Fig. 2). The first column gives the octal address of the instruction on the plugboard. Error codes can then follow. Next is a 24-bit instruction pattern which is to be represented on the plugboard with diode pins. It has been found that this format makes plugging a program into the plugboard quite simple, since no specific knowledge of the controller's instruction format is required.

APPLICATIONS

For the system with fast serial link to the PDP-10, programs have been written to handle:

. Displaying nuclear physics spectra (see Fig. 2) and character strings on a Tectronix 611 scope;
. Controlling nuclear magnetic resonance magnets;
. Reading kicksorter data (see below).

The stand alone system has been used successfully for debugging PDP-10/PDP-7 CAMAC interface modules.

A KICKSORTER (ANALYSER) READOUT SYSTEM

The serial interface system is used, in conjunction with two specially designed modules, to read the memory of a LABEN 8000 Multi-Channel Analyser (4-8 k core) and write the contents to the PDP-10. The two special modules are the LABEN M.C.A. interface and a CAMAC/LABEN level converter (referred to as the LABEN 8000/M.C.A. interface in Fig. 1). As most of the physicists' experimental equipment is in NIMS crates, the level changer is a single width NIMS unit which can also be inserted into a CAMAC crate with a NIMS/CAMAC adaptor (as in Fig. 1).

The 7025 controller program is constantly cycling, waiting to receive a control word from the PDP-10. It then turns the kicksorter (MCA) into DATA OUT mode and calculates the number of channels to read, which it transmits to the PDP-10. After converting each 24-bit kicksorter data word into four 6-bit bytes, the data transfer is then made through the fast serial link. At the end of the transfer, the 7025 sends an end-of-file character and returns the kicksorter to DISPLAY mode.

The 7025 controller program has sufficient error trapping to recover and reinitialise itself on all possible errors. Because the 7025 is a serial controller, the cycle time is 6 micro-seconds and it takes half a millisecond to transfer one 24-bit word to the PDP-10. Consequently, it takes four seconds to read the contents of an 8 k LABEN kicksorter.

CONCLUSION

The kicksorter readout system has been running reliably now for six months and another serial link has been constructed for a second single crate system.

At the moment the program for the 7025 controller has to be plugged into its associated 7077 memory manually. However, with the advent of read/write CAMAC memories (eg. NE CS0015), the CONCO assembler is being extended to load the program into this type of memory directly.

Where certain tasks (such as kicksorter readout) become well-defined, programmable read only memory modules (PROM's) could be used; again, the loading or 'burning-in' of the memory would be directed by a CONCO loader.

IDEAS AND TECHNIQUES

1

A STANDARD FORMAT FOR CAMAC DEVICE SPECIFICATIONS

by

J.-B. Bossel and H. Klessmann
Hahn-Meitner Institut für Kernforschung Berlin GmbH, Berlin, Germany

Received 21st September 1972. Revised 8th March 1973

SUMMARY A standard format for presenting the hardware and software characteristics of CAMAC equipment has been designed in order to assist system set-up and programming. The characteristics of each device are recorded on a form that can be used as one page of a CAMAC instrumentation file or catalogue.

INTRODUCTION

The growing spectrum of commercially-available CAMAC equipment presents increasing difficulties (even to users familiar with CAMAC) in selecting instrumentation which is best suited to the needs of a specific experiment. As an attempt to cope with this problem the Department of Electronics at the Hahn-Meitner-Institut has started to set up a file which includes all relevant data of CAMAC devices used at HMI, either commercially-available or designed by the Laboratory. Each page of this catalogue contains the characteristics of a single device on a standardized fill-in form. The characteristics of sophisticated modules with several different operational applications may be given in different sections of the catalogue.

The main intentions in introducing this standard format were:

. To ease the selection of an instrumentation module for a given application.
. To allow valid comparison between equipment from different sources.
. To assist programming by presenting the hardware and software features of each specific device in an easily-understood scheme.
. To draw attention to modules which either have remarkable characteristics, or do not fully conform to the mandatory and recommended requirements of the CAMAC specifications, EUR 4100e or EUR 4600e and their revisions.

STANDARD FORMAT

The format for specifying the characteristics of a CAMAC device is given in Fig. 1 — with data of a Real Time Clock given as an example. The fields of the format are numbered to allow cross-referencing, and implementation of the catalogue by means of a computer. The following notes describe the type of information in each field, although most designations are self-explanatory.

1. CLASSIFICATION:
2. CODE:
   These fields are reserved for the classification and the decimal classification code of the device, in the scheme[1]: used for the Product Guide in CAMAC Bulletin.
   If a sophisticated module has been classified in several categories all relevant codes are given, and the specific code pertinent to the actual file page is stressed.
3. DESIGNATION:
   Gives the manufacturer's designation.
4. MANUFACTURER:
   Name of manufacturer or design source.
5. TYPE/VERSION:
   Gives the manufacturer's identification and indicates updated or new versions, e.g. by serial numbers, if there are different versions of a device with otherwise identical designation and type.
   A diagonal line across this field indicates that the device has been replaced by an equivalent one.
6. PRICE:
   The price actually paid, or quoted more recently.
7. WORDS/BITS:
   Gives some indication about the bit handling capability.
8. RANGE/RESOLUTION/ACCURACY:
   Indicates performance in the frequency, time or any other domain.
9. SUPPLY:
   The requirements for supply voltages and currents are some guide to the internal design and are indispensable for system design.
10. WIDTH:
    Gives the number of unit widths (1/25).
11. I/O SIGNAL/NAME TYPE/POLARITY CONNECTOR:
    All relevant data about input signals to or output signals from the CAMAC device via front panel or rear connections, including patch and free bus lines.
12. MANUAL CONTROLS:
    Summary of all manual inputs via switches push buttons etc.
13. DISPLAYS:
    Summary of all indicators presenting the operational status.
14. DATAWAY FUNCTIONS:
    Summary of all CAMAC functions implemented. Use of non-standard functions and possibly partial decoding of Subaddress- or Function-Lines is indicated in field 17. In the case of partial decoding a comparative table appears in field 16.
15. DATAWAY STATUS/ CONTROLS:
    Summary of all CAMAC status and control signals used and their application.
16. DATAWAY COMMAND OPERATIONS:
    Explanatory listing of all CAMAC Command Operations that can be performed including the Q-line response. If the Subaddress (A) and Function (F) lines are not fully decoded a comparative table is included giving the device response for all A- or F-codes. The information given in this field has proved to be most helpful for efficient programming as the general performance of a device is quickly understood and all features available are summarized.
17. COMMENTS:
    Comments are generally included directly in the fields where they apply. However, additional remarks or more elaborate explanations for better understanding may be given here. This field includes important comments drawing attention to the use of non-standard function codes, to partial decoding of A of F, and to any non-standard uses of the Dataway lines (not conforming to EUR 4100). Finally, for multi-width devices, there is provision for recording whether the device is addressed by the N-number of the right-most a left-most station that it occupies.

CONCLUSION

The method described for setting up a file of data specifications for CAMAC instrumentation has been applied to more than 50 CAMAC modules and other CAMAC devices used at the Hahn-Meitner-Institut Berlin. It is based on the manuals supplied by the manufacturers, a check of the actual circuit drawings and the operational experience obtained from test runs with a computer. It is felt that the standard form satisfies all needs for selection, comparison and programming of CAMAC instrumentation where detailed data of specification and performance of CAMAC modules, simple as well as sophisticated ones, must be readily available. However, equipment that is not related to the Dataway concept but is primarily used for controlling CAMAC systems or for interfacing to a computer, such as Branch Controllers, may possibly require another format for specification.

REFERENCE

O. Ph., Nicolaysen Decimal Classification of CAMAC Instrumentation, *CAMAC Bulletin*, No. 7 (This Issue).

CAMAC DEVICE DATA SHEET | DATE

1 CLASSIFICATION			2 CODE

3 DESIGNATION	4 MANUFACTURER	5 TYPE / VERSION	6 PRICE
REAL TIME CLOCK Mode: clock, elapsed time	SEN	RTC 2014	

7 WORDS / BITS	8 RANGE / RESOLUTION / ACCURACY	9 SUPPLY	10 WIDTH
16 BIT	Range : 0,25 s to 18h 17 Resol. : 3,8 us to 1s WITH Internal Osc.	+6V/640 mA -6V/ 90 mA	1/25

11 I/O / SIGNAL / NAME			TYPE / POLARITY	CONNECTOR
OUT	Int. Osc. 262kHz	OUT8[6]	NIM 1,9us	1 LEMO
IN	Clock Input	IN A	connected together	1 LEMO
IN	Clock Input	IN B	NIM 30ns, 50 Ω	2 LEMO parallel
IN	Start Pulses	RESTART	NIM 50ns, 50 Ω	1 LEMO
IN	Stop Pulses	STOP	NIM 50ns, 50 Ω	1 LEMO
OUT	Busy Flag	BUSY	NIM	1 LEMO
OUT	Clock Overflow	END	NIM	2 LEMO parallel

12 MANUAL CONTROLS	13 INDICATORS
	BUSY: ON= Clock running OFF= Clock stopped

14 DATAWAY FUNCTIONS	15 DATAWAY STATUS / CONTROLS
Mode Clock only ! F(0), F(8), F(10), F(16), F(24), F(26), F(28). Non-standard Function: F(28)	L gated by B L ENABLE/DISABLE LAM= Clock Overflow ☐ X ☒ Z ☒ Q ☐ C ☒ L ☐ I ☒ B ☐ P1 ☐ P2

16 DATAWAY COMMANDS WITH Q - RESPONSE AND SIGNIFICANCE

F(0)A(0)	Q=1	READ Clock Time: R1 to R16
F(8)A(0)	Q=LAMxENABLE	TEST LAM= Clock Overflow
F(10)A(0)		CLEAR LAM
F(16)A(1)	Q=1	OVERWRITE Resolution Selector: W1 to W7 17 If W1 to W7 all zero: STOP Clock
F(24)A(0)	Q=1	DISABLE LAM
F(26)A(0)		ENABLE LAM
F(27)A(0)	Q=BUSY	TEST STATUS BUSY= Clock running
F(28)A(0)	Q=1	START Clock with preselected resolution CLEAR LAM

Comparative Table for A:
A(0)=A(4)=A(8)=A(12)
A(1)=A(5)=A(9)=A(13)

Summary of START/STOP conditions:
START= (a) RESTART Pulse: BUSY ON
(b) F(28)A(0) : CLEAR LAM, BUSY ON
STOP= (a) STOP Pulse: NO LAM, BUSY OFF
(b) F(16)A(1) (W1-W7)=0: NO LAM, BUSY ON
(c) Overflow: END Pulse, LAM, BUSY OFF

17 COMMENTS 8 Resolution/Bit set: 3,81us/W1; 30,5us/W2; 244us/W3; 1,95ms/W4; 15,6ms/W5; 125ms/W6; 1s/W7.
Max. elapsed time/Bit set : 0,25s/W1; 2s/W2; 16s/W3; 128s/W4; 17'04"/W5; 2h16'32"/W6; 18h12'16"/W7.
16 Only ONE of W1toW7 must be set at a time

☒ NON-STANDARD FUNCTIONS USED
☐ F ☒ A-LINES NOT FULLY DECODED
☐ DATAWAY NOT USED ACCORDING TO 4100 SPECS
☐ RIGHT- ☐ LEFT-MOST STATION ADDRESS

Fig. 1 Form for Describing the Characteristics of CAMAC Equipment

NEWS

CAMAC SYSTEM TEST MODULES AT LAWRENCE BERKELEY LABORATORIES

A report received from Mr. L. J. Wagner describes two test modules developed at the Lawrence Berkeley Laboratory. One is a general-purpose test module, with special features for testing systems that use the three block transfer modes described in the 1972 CAMAC Specification. The other tests data transfers that are synchronised by 'handshaking' via the Look-at-Me signal.

CAMAC System Test Module

To test systems that access subaddresses sequentially in Address Scan Mode this module provides read access to its data register at four subaddresses, and generates $Q = 1$ at A(0-3) and $Q = 0$ at A(4). For systems that transfer data in Stop Mode at one address the module simulates an 8-word block transfer, generating $Q = 1$ on the first eight read transfers from A(12), and $Q = 0$ on subsequent accesses to indicate end-of-block. For systems that use Q to indicate readiness in Repeat Mode the module gives a $Q = 1$ response to one read access at A(13), and then gives $Q = 0$ to any further accesses until an internal dead-time has elapsed.

CAMAC System Test Module for L-Synchronised Block Transfers

This module simulates an 8-word block transfer source. A test sequence is initiated by an Execute command. The module generates $L = 1$, clears to $L = 0$ when this is acknowledged by a read command, waits for a known time, and then generates $L = 1$ again. This is repeated eight times.

Detailed Information

Complete technical information on these two modules is available from the Technical Information Division at Lawrence Berkeley Laboratory for the cost of reproducing prints. Ask for 12×9991-P2 with all prints, and 12×2251-P1 with all prints, respectively.

2

DECIMAL CLASSIFICATION OF CAMAC INSTRUMENTATION

by

O. Ph. Nicolaysen

NP Division, CERN, Geneva, Switzerland

Received 8th March 1973

SUMMARY A decimal classification scheme for CAMAC instrumentation is described. This will be used, in place of an earlier scheme, for the computer-produced Product Guide in CAMAC Bulletin, starting at Issue No. 7. The scheme could be extended to include software and general subjects related to CAMAC.

INTRODUCTION

The product guides in CAMAC Bulletin and CERN-NP CAMAC NOTES[1] are prepared by NP Division at CERN, using a computer to arrange the information according to a decimal classification scheme. This classification has now been revised, in the light of experience, in order to correct some shortcomings. This paper describes the principles of the revised classification, which has been used in preparing the product guide in this issue of CAMAC Bulletin.

CLASSIFICATION PRINCIPLES

The proposed system resembles the Universal Decimal Classification system used for documentation purposes. It is founded on two basic principles.

. It is a *classification*, depending on criteria so defined that related concepts, functions, or characteristics, or groups of such, are brought together.
. It is a *decimal classification*, proceeding from the general to the more particular by the division of CAMAC topics and instrumentation into main classes, each of which is further subdivided decimally to the required degree.

STRUCTURE NOTATION

All topics related to CAMAC, computer software for CAMAC (programs), and CAMAC instrumentation and related equipment, can be regarded as a unity which we devide into various classes, denoted by decimal fractions as follows:

.0 Generalities, methods, applications, documentation, software.
.1 Data modules (I/O transfers and processing).
.2 System control (computer couplers, controllers and related equipment).
.3 Test equipment.
.4 Crates, supplies, components, accessories.

The structural breakdown into main classes proceeds from the general to the more particular, and the notation is extended by building up the decimal fraction, thus:

.1 Data modules (I/O transfers and processing).
.11 Digital serial input modules (scalers, counters).
.112 Simple serial decade registers.
.112.2 Dual serial decade registers.
.112.23 Dual serial 4-decade registers, freq. ⩾ 100 MHz.
.112.231 Dual serial 4-decade registers, freq. ⩾ 100, NIM I/p signal.

For a better understanding of the decimal classification as shown in the example, one should keep in mind three things:

. The main class is always represented by the most significant digit, lower-level classes have less significant digits.
. The level of subdivision or degree of detail in specifying the class is represented by the length of the decimal fraction.
. The Decimal Classification implies that a class is represented by a decimal fraction, i.e. a number less than unity, although one may, for convenience, omit the initial point and insert other points as visual aids.

It is obvious that we may go to any degree of subdivision, and use decimal fractions of various lengths, as appropriate. The system provides the desired flexibility for the most diversified applications. In practice subdivision to the third or fourth level will usually suffice.

DEFINITION OF CLASSES, CRITERIA

The definition of classes and subclasses is here only carried down to the fourth decimal fraction, or fourth level. Further subdivision can be undertaken as required.

The Overall Subject : CAMAC

The criterion for inclusion is defined by:

. Devices or equipment are included if they are specially designed for use with CAMAC or are otherwise declared as recommended or standard for use with CAMAC. General concepts or ideas related to CAMAC are also included.

This criterion excludes, for instance, computers and software (unless specifically designed for CAMAC), and includes interfaces. It excludes various components that are often used, but not specifically designed of producted for CAMAC.

Main classes

A CAMAC system can be regarded as an integral part of a process, where the combination of computer-interface-driver-controller carry out, in general, the controlling function. Modules have as their general function the interconnection of the Dataway and the external process.

We take the general function of a device as the criterion for defining its main class (denoted by a one-digit decimal fraction .1, .2 etc) as listed above.

Main class .0 covers aspects of CAMAC other than hardware. It is not used in preparing the present product guides, and is not discussed further in this paper, where all examples are taken from classes .1 to .4.

In some cases, a set of devices belong naturally together (for example each device may depend for its proper function on other devices in the set). To retain unity we may, for listing purposes, assign the set of devices to the class which most closely corresponds to the principal function of the set as a whole.

Subclasses

The selection of criteria for defining classes of various levels is important, so that cross references are reduced, and uncertainties in assigning correct class are excluded if possible. Suitable criteria for lower levels of subdivision are suggested below.

2nd level criterion:

Specific function.

.21 Interfaces/Drivers and Controllers (Parallel Mode).

.22 Interfaces/Controllers/Drivers for Serial Highway.

.23 Units related to 4600 Branch or other parallel mode control/data bus.

3rd level criterion:

General characteristics.

.121 Non-storing registers (gates).

.122 Storing registers.

4th level criterion:

Specific characteristics.

.132.1 Parallel Output Modules: Single Register.

.132.2 Parallel Output Modules: Dual Register.

Subdivision to lower levels than shown above is possible. Suitable criteria for these levels are even more specific characteristics.

MODULE DESCRIPTOR

The classification code gives certain information about the function and characteristics of modules. It could therefore be used as part of a module descriptor (see EUR 4100e (1972), Section 6, page 29).

REFERENCE

CERN-NP CAMAC Note 23-nn, 'CAMAC PRODUCTS REFERENCE' is issued at irregular intervals. It lists CERN-developed CAMAC equipment, an index of commercial CAMAC products, and an index of manufacturers.

APPENDIX

OUTLINE OF THE MAIN CLASSES AND SUBDIVISIONS

1	*Data Modules (I/O transfers and processing)*
11	Digital serial input modules (scalers, counters)
111	Simple serial binary registers
112	Simple serial decade registers
113	Preset serial binary registers
114	Preset serial decade registers
117	Other digital serial input registers (bi-directional, serial-coded)
12	Digital parallel input modules
121	Non-storing registers (gates)
122	Storing registers
123	Terminated signal input registers (coinc. latch, pattern, etc.)
124	Manual input modules (word generators, parameter units)
127	Other parallel input modules (incl. LAM and Status registers, see 232 for LAM Grader)
13	Digital output modules
131	Serial output modules (clocks, timers, pulse generators)
132	Parallel output modules (TTL, HTL, NIM, etc.)
133	Parallel output drivers (open coll., relay drivers, etc.)
137	Other parallel output modules
14	Digital I/O, peripheral and instrumentation interfacing modules
141	Serial I/O registers (general purpose)
142	Parallel I/O registers (general purpose)
143	Peripheral interfacing modules (for TTY, printer, tape, etc.)
144	Display modules, display and plotter interfacing modules
145	Instrumentation interfacing modules (DVM, supply controllers, pulse analysers, stepping motors, etc.)
147	Other digital I/O modules (incl. data links)
15	Digital handling and processing
151	Gates (AND/OR/NOT) fan-outs
152	Digital level converters
153	Code converters
154	Buffer memory, storage units
155	Logic and arithmetic processing modules
157	Other types (incl. delay units)
16	Analogue modules
161	Analogue input modules (DC and pulse type ADC, TDC)
162	Analogue output modules (DAC)
163	Analogue I/O modules (ADC/DAC, etc.)
164	Analogue handling and processing modules I (Analogue Multiplexers)
165	Analogue handling and processing modules II (lin. gates, ampl., discrim., etc.)
167	Other analogue modules
2	*System Control (computer couplers, controllers and related equipment)*
21	Interfaces/drivers and controllers (parallel mode)
211	Interfaces/drivers for multicrate systems I (4600 branch)
212	Interfaces/drivers for multicrate systems II (other control/data bus)
213	Interfaces/drivers for single-crate systems (4100 compatible)
214	Controllers for autonomously operated systems (and related units)
217	Other parallel mode interfaces/drivers/controllers
22	System interfaces/controllers/drivers for serial highway
23	Units related to 4600 branch or other control/data bus
231	Crate controllers (type A-1, other CC's)
232	LAM graders
233	Terminations (simple, with indicators)
234	Branch extenders, bus extenders
27	Other system control related gear (incl. system-system links)
3	*Test Equipment*
31	System related gear
311	Computer simulators
32	Branch related single- and multi-crate controllers/testers
321	Controller/testers (manual, programmed)
322	Branch displays
33	Dataway related testers
331	Dataway controllers/testers
332	Dataway displays
34	Module related test gear
341	Module extenders
37	Other test gear for CAMAC equipment
4	*Crates, Supplies, Components, Accessories*
41	Crates and related components/ accessories
411	Crates with Dataway and supply
412	Crates, with Dataway, without supply
413	Crates without Dataway, with supply
417	Blank crates, and other components and accessories
42	Supplies and related components/accessories
421	Multi-crate supplies
422	Single-crate supplies
427	Blank supply chassis, and other components and accessories
43	Recommended or standard components/accessories
431	Branch related (cables, cable assemblies, connectors, etc.)
432	Dataway related (Dataway connectors, PC boards and assemblies)
433	Module related (blank modules, PC boards, patchboard modules)
437	Other recommended or standard components/accessories.

NEW PRODUCTS

DATA MODULES (I/O Transfers and Processing)

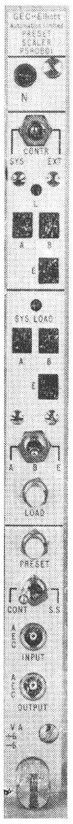
Digital Serial Input Modules

Quad (50 MHz) Scaler

The S424S Quad Scaler is a quad, 24-bit, 50 MHz scaler with a command structure identical to the S424B, (150 MHz) scaler, allowing direct interchangeability. The S424S exhibits all the normal features of a high quality scaler and will respond to positive TTL inputs as well as the more usual negative NIM fast logic signals.

Ref. EG & G/ORTEC

Preset Scaler



The preset register Type PSR 0801 is a single-width module containing one 8-decade, count-down scaler. Seven segment LED display are used to present both the scaler contents and the preset number in floating point form,

$$A.B. \times 10^{E}.$$

The preset number may be entered from the Dataway or via simple front-panel controls; or it may be automatically reloaded at the end of a count-down. The output can be:

Level: logical '1' when scaler content is zero until new number preset.

Pulse: logical '1' pulse, on reaching zero content; of variable width.

Serial: input pulses are transferred to the output until the content is zero.

The maximum p.r.f. is 20 MHz and the minimum input pulse-width is 20 ns. The unit is electrically equivalent to the CERN 025 Preset Scaler.

Ref. GEC-Elliott-Process Automation

Digital Parallel Input Modules

Dual Input Registers

These modules contain two independent registers, each of which stores 24 bits of data from one of the front-panel connectors. A transfer to one of the registers may be initiated either by Dataway command or by the appropriate external data source through handshake signals. The option is determined by switches inside the unit that, together with links, also determine the polarity of the handshake signals and data. A transfer causes a Dataway L signal which inhibits further transfers to that register until the L has been cleared which would normally be on the Dataway command that reads the contents of that register. L may be read, enabled and disabled by Dataway command.

Two models are available. The 9041A has low impedance terminations for use with twisted-pair cables, and the 9041B accepts CAMAC unterminated signals. The input connectors are the 58-way EMIHUS variety and signal and return terminations are provided.

By means of internal link the mode of operation and the polarity of handshake signals can be adjusted and versions with positive logic input can be supplied.

Ref. Nuclear Enterprises

Parallel Input Register

This 2×24-bit input register type JRE 10 allows a peripheral to be master or slave in a CAMAC system.

Data are strobed into the register by a synchronisation signal generated by the peripheral.

- Peripheral acting as the master: the peripheral sends data by master synchronisation signal (SYM). At the end of the CAMAC cycle, the register asserts the slave synchronisation signal (SYS) and the system is ready for another transfer.
- Peripheral acting as the slave: Data request is made by F(25) and the register asserts a SYM, to the peripheral which sends data by a SYS.

Data transfer may be performed in Repeat mode without LAM handling by means of Q test.

Two other operation modes are possible:

Pattern unit: The system works in the 'peripheral master', data are strobed into the register and L is asserted by an external triggering pulse.

Static data: The register follows the state of the peripheral except when the register is read. No Lasserted.

Ref. SAIP-Schlumberger

Digital Output Modules

Real Time Clock

The Joerger Enterprises Real Time Clock model RTC counts and displays elapsed time. It uses the a.c. supply as a clock source and counts to 999 days with a resolution of 0.1 sec. A front-panel, 6-digit LED display indicates hours, minutes and seconds. Time information may also be read out on the Dataway from storage registers that are updated synchronously with the clock to insure an error-free readout.

An interrupt structure is provided which allows interrupts to be generated every second, minute, hour or day and thus provide a convenient source of timing signals. An Error light is provided to indicate that a power dropout has caused the time data to be incorrect. This is also read out as a bit on the Dataway.

An internal power supply is offered as an option that will provide power to the counting section making it independent of the crate power. Remote readout is also offered optionally.

Functions Used: F0, 8, 10, 24, 26.
Size: double-width.
First Delivery: 3/73.

Ref. Joerger Enterprises

Crystal Controlled Clock Generator

The model CG is a 10 MHz crystal-controlled clock generator. It provides 8 outputs simultaneously in decade steps from 10 MHz to 1 Hz. It can also accept an external clock of up to 50 MHz and provide 8 outputs in decade steps. These outputs are capable of driving both CAMAC TTL type inputs or fast signals into 50 ohms. This allows the convience of using these outputs to drive all type CAMAC inputs.

A program controlled frequency output is available as an option. This output is controlled from the Dataway which can select any of the 8 output signals available. A 3-bit register is provided to store the address of the selected frequency. This allows a convenient method of changing the time scale of an experiment.

When this clock generator is used in conjunction with the model S2 Preset Scaler the pair can perform such things as generation of an accurate gate or time-base or a pulse burst with a pre-selected number of pulses, to mention a few of the many possibilities.

Functions Used: F16.
Size: single-width.
First Delivery: 3/73.

Ref. Joerger Enterprises

Dual Output Registers

These modules contain two independent registers each storing 24 bits of data, which can be loaded and read from the Dataway. The data are presented permanently at two front-panel connectors. Data transfers to a peripheral can be controlled by handshake signals and can be initiated either from the computer or from the peripheral. In either mode the signal from the peripheral initiates a Dataway L signal to request new data.

Two models are available. The 9043A has a low impedance source for use with twisted-pair cables and the 9043B gives unterminated CAMAC signals out but may also be used to drive lamps or relays.

The polarity of the handshake signals and the mode of operation may be adjusted by internal links.

The output connections are via 58-way BMIHUS connectors.

Ref. Nuclear Enterprises

Dual Output Register

The module type 9042 contains two independent registers which can be loaded and read from the Dataway. The data is presented permanently at two 25-way Cannon sockets and the outputs can withstand +30 volts and sink 40 mA. An output strobe of presettable duration is provided for each register as soon as new data has been loaded.

Ref. Nuclear Enterprises

Output Register OR

The model OR contains a 48-bit register. This register may be used as two 24-bit registers or as six 8-bit registers. This allows the word length to be chosen to meet the system requirements more closely and therefore avoid losing register capacity because the register is longer than the system word. The outputs are high current TTL drivers, and can be either pulses or a.c. levels. The registers are also capable of being read back onto the Dataway for verification. As an option the contents of the registers can be read out visually on 48 front-panel LED indicators.

Functions Used: F16, 17.
Size: single-width.
First Delivery: 4/73.

Ref. Joerger Enterprises

Parallel Output Register

This 2 × 24-bit parallel output register type IRS 10 allows a peripheral to operate as master or slave in a CAMAC system.

— Peripheral acts as the master:
When the peripheral needs data it asserts the master synchronisation signal (SYM) and the register asserts a look-at-me to the CAMAC system. Data from Dataway are strobed in the register on F(16). Then the register generates a slave synchronisation signal (SYS), which strobes data input in the peripheral, the nresets SYM. The system is ready for a new transfer. SYM may be replaced by an external triggering pulse.

— Peripheral acts as the slave:
When a system is ready for a transfer, the register asserts SYM, which strobes data in the peripheral. The peripheral then asserts SYS. The register resets SYM and the peripheral SYS. The system is now ready for another transfer. SYS may be replaced by an external triggering pulse.

Data transfer can be performed in Repeat mode, without LAM handling, by Q test.

Ref. SAIP-Schlumberger

Digital I/O and Peripheral Interface Modules

Data Receiver

A unit is offered which is intended to control mechanical operations via CAMAC systems, as required by small machine tools or other types of industrial equipment that use stepping or dc motors, tap and lever controls etc. This data receiver (model C501) is one part of modular numeric control systems implemented by RDT. For such systems, data stored on magnetic tape are transferred to the data receivers via a special serial controller.

The unit contains instructions and data registers with associated buffer register which can be loaded not only serially but also in parallel from the Dataway Write lines. The data registers have a word-length of five decimal digits, to allow for mechanical displacements with an accuracy of 10 ppm, and are presettable count-down registers.

The instruction register has a word size of three decimal digits to determine the direction of movement, to enable a LAM source, to perform three different mechanical actions and to enable speed variation of movements.

Ref. Rosselli del Turco-RDT

Input/Output Register

The model IR contains two 24-bit registers. These registers may be clocked continuously, on command, or by a single event automatically clocking up the register until read out. The data inputs are unique in that they have high input impedance and each input is arranged to accept up to three input components. This allows the inputs to be clamped, integrated or the levels shifted if required to meet the particular input signals to be processed. This may be done at the factory. The module can also be supplied to accept CAMAC compliment signals instead of true logic levels. This type of input will prove useful due to the wide variety of input signals that may be handled.

Whenever the registers are updated a LAM signal is generated. To interlock the external unit to the dataway an Acknowledge signal is generated, which is this LAM signal. It goes to a Logic '1' when the register is updated and remains there until the data is read out.

A 12-bit output register is offered as an option. This enables the module to control or address the external device it is interfacing in addition to reading it out.

A visual indication of the contents of the input registers may be read out on 48 LED front-panel lights as an option.

Functions Used: 0, 2, 8, 10, 16, 24, 26.
Size: single-width.
First Delivery: 4/73.

Ref. Joerger Enterprises

Display Driver

This double-width module type DD1601 will drive an X-Y display oscilloscope (for example the Hewlett Packard 1300) to produce real-time alphanumeric and graphical information. It was designed in collaboration with Daresbury Nuclear Physics Laboratory (SRC), and includes point plot, character and vector generators. The control register contains a 3-bit Z modulation word which may be used for 3 colours or 8 brightness levels, depending on the type of oscilloscope used. A built-in delay, to allow the X and Y deflections to settle before the application of bright-up pulses, may be preset to either 200 ns or 8 μs, while character definition is in 7×5 font, in 6 different sizes. A further module (single-width) is planned to provide signals for storage oscilloscope displays (such as the Tektronix 611).

Ref. GEC-Elliott-Process Automation

Scope Driver

The JDD 10 double-width CAMAC unit, is intended for CRT display instruments.

There are four operation modes possible for point plots, histograms, vectors and characters.

A light pen may be superposed either by program or by a manual control device MC 10.

The JDD 10 may also operate as a recorder driver. In this case a pen control signal is available on the front panel.

Ref. SAIP-Schlumberger

Stepper Controller

The Stepper Controller C-STC-4 is a double-width unit containing all the necessary circuits to control a stepping motor (start, stop, turning speed and direction of movement).

Turning speed and direction are controlled with a comparator comparing registers containing the required and current values of digitized angular settings. The registers are loaded or read via the Dataway 16-bit registers are available, i.e., an accuracy of angular setting of 0.006 degrees can be obtained. Turning speed and direction can be controlled also directly from a computer.

The unit is equipped with a 16-bit status register and a 12-bit module characteristic can be implemented.

Ref. Wenzel Elektronik

Digital Data Handling and Processing Modules

Binary Code Converter

The module type 9044 is designed to perform either binary to binary-coded-decimal conversion (BCD) or BCD to binary conversion. BCD data may be entered either from a front-panel input socket, or via the Dataway, and the resultant binary information may be read via the Dataway. Binary information can be entered via the Dataway and the resultant BCD information is presented at an output socket and may also be read via the Dataway. Data input/output signals are accompanied by handshake control signals to synchronise conversion requests to the speed of a peripheral.

Worst case conversion speed is 11.2 microseconds. This may be optimised by adjustment of the internal clock oscillator to a minimum of 5.6 microseconds. The module will handle seven decades of BCD information.

Ref. Nuclear Enterprises

256 Word Store

This single-width module type CS 0015 contains 256 words of 24-bit random access memory for use as a Dataway store or as a program memory for the 7025 Programmed Dataway Controller. It has a facility for switching to a stand—by voltage source in the event of power failure with low current drain in this state. Other features include four 8-bit temporary registers for storage of program-jump-return addresses and an instruction buffer register so that an instruction may make access to the store for data transfer.

Ref. Nuclear Enterprises

Analogue Modules

Octal Charge Digitizer

The QD808 Octal Charge Digitizer contains eight individual charge sensitive ADC's and 8-bit storage registers coupled to a common gating input. The fast linear gates and stretchers will accept gate widths of less than 5 nanosec., and the unit has a full scale range of 125 pico coulombs. Significant features of this unit are analog summing of the input charge, a fast clear input for hard-wired decision making, high stability, LAM logic and readout data compression into four 16-bit words.

Ref. EG & G/ORTEC

Quad Time Digitizer

The TD104 Quad Time Digitizer has a common start and four individual stop inputs. Each section has, as standard, a full-scale range of 200 nanosec. with a channel width and resolution of 200 picosec. Overrange detection is accomplished by presetting the 10-bit data registers to 'all ones'. The unit features excellent stability with LAM capability and a built- in test feature triggered by F25.

Ref. EG & G/ORTEC

8 Channel DAC

This single-width module, model DAC 1081, contains eight identical 10-bit DAC channels, each channel having its own register, and its own digital-to-analogue converter.

Either two's complement ± 5 V or binary 0-5 V options are available. Analogue outputs satisfy the mandatory requirements of EUR 5100, and will drive a 50 ohm load from either a 50 Ω output impedance or an output impedance ≤ 1 ohm. Plus and minus full scale (or zero and full scale) for each channel may be adjusted from the front panel. Non-linarity does not exceed 0.05% full-scale, drift is less than 1.0 mV/°C and slew rate is better than 2 V/μs.

The monolithic DAC integrated-circuit elements are fitted in sockets for ease of servicing. Units can be supplied sub-equipped.

Ref. GEC-Elliott-Process Automation

SYSTEM CONTROL (Computer Couplers Controllers and Related Equipment)

Interfaces/Drivers and Controllers (Parallel Mode)

Microdata 800/CIP 2000 Branch Driver

The model 91 is a general purpose interface between the Microdata 800 series computers, and the CAMAC Branch Highway is also applicable to the Cincinnati-Millacron CIP 2000 series computers. The model 91 makes use of macrocommands normally microprogrammed in Micro 810, 812, and 820 computers (CIP 2100/2200), but may be used with the basic Micro 800 system with suitable microprogramming.

Ref. Jorway Corporation

PDP-8 Interface Board

The type 9034 is designed to plug into the interface-card-option slot of the type 9030 Computer Controller and interfaces the Controller directly to a PDP-8E or PDP-8L computer via an I/O Bus Interface Unit. For a PDP-8 or PDP-8I with a negative bus, the Bus Interface must be equipped with an optional level-changer card. Connection is made to the Bus Interface via a 132-way cable, and the Bus Interface connects to the computer bus using three flexprint cables.

Combined with the 9030 to form a CAMAC interface to the PDP-8 series, the unit is capable of 24-bit program transfer operation and will interface a single crate in its basic form. It may be extended for a multi-crate system by connection of a Branch Interface type 9031 module within the master crate. It is possible to extend the system still further by using a number of 9031 modules to drive different Branch Highways. Interrupts are serviced by poll or by 24-bit graded LAM read operations. All data is buffered in the internal registers of the 9030 so that interface timing is independent of the mark of PDP-8 used.

Ref. Nuclear Enterprises

CAMAC Crate - PDP-11 Interface

The JCC 11 is a program-controlled interface between the dataway of a CAMAC crate and the unibus of a PDP-11 computer.

A CAMAC system linked to PDP-11 by means of JCC 11 needs no crate controller; dataway timing is performed by JCC 11.

This double-width CAMAC module allows two powerful features:

- CAMAC data-registers directly adressable from unibus;
- fast interrupt handling.

Up to 11 CAMAC crates may be linked to a PDP-11 computer by means of JCC 11. An expanded addressing facility whereby each CAMAC module in the crate can have up to $16 \times 8 = 128$ directly addressable registers, can be provided for one crate in an 11-crate system and for two crates in a 6-crate system.

Ref. SAIP-Schlumberger

Dedicated Crate Controller for PDP-11

The DC011 Dedicated Crate Controller provides an interface between the PDP-11 Computer and the CAMAC Dataway. This unit which occupies only the last two stations of each crate has been designed for high performance at low cost. The DC011 uses only four UNIBUS addresses and offers the fastest program controlled data transfer possible with multiple transfer operations or automatic address scanning. LAM requests are handled by 23 LAM vectors which cause the computer to transfer directly to one of 23 individual LAM service subroutines. In order to monitor errors, the seven most useful status bits are located in one register. All CAMAC controller commands have the same FNA as the Type A Controller and multiple crate systems are possible.

The DC011 combined with a CAMAC Crate and Power Supply is available at a special low price to bring CAMAC within the reach of many experimenters.

Ref. EG & G/ORTEC

System Interfaces/Controllers/ Drivers for Serial Highway

Controller for Borer 3000 Distributed Data Multiplexer

Extensive flexibility in system planning and building is provided by the Type 1551 Distributed Data Multiplexing Controller. Intended for widely and randomly scattered data acquisition and control, it operates in an extremely reliable line-sharing mode, using only a single twisted-pair cable.

Built as a double-width CAMAC module, any number of such controllers may be operated from a single computer, together with any arbitrary combination of CAMAC-compatible instruments, (clocks, display drivers etc.). Thus, an installation can be conveniently composed of both local input/outputs interfaced directly through CAMAC, and remote distributed input/output points interfaced via BORER 3000. Each controller can manage a ring cable having up to 256 terminals, so that the potential capacity of the whole installation is practically unlimited.

A number of registers are included in each controller which can be read or over-written by the computer via the CAMAC Dataway. These indicate and/or accept the system status, terminal address, sub-address, incoming and outgoing data, interrupt address and data etc.

Ref. Borer Electronics AG

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

---

Type A-1 Crate Controller

The model 70A Type A-1 Crate Controller fully conforms to the latest CAMAC specifications EUR 4100 and 4600.

Using 'CERN Preferred Values' as a guideline, a synchronous timing generator provides an accurate timing sequence. This assures the ability to perform branch operations at a maximum cycle rate. Very high input impedance on all branch input lines results in loading (50 μa typical), far less than the maximum permitted, contributing to cleaner signals on these lines. The model 70A incorporates circuits to guard against the possibility of having two crates set to the same address. If an address is selected which is already occupied, the unit will revert to the Off Line state and remain so until the conflicting situation is rectified. This is particularly useful when a branch has crates in remote locations, and will prevent interference in an operating system if an incorrect address is chosen. Front panel indicator lights provide visual controller status information, valuable during normal operation and especially as an aid in trouble shooting and debugging of both hardware and software.

Two additional modes of operation are included, 'Hold' and 'Fast Read'. Both are 'optional' in that they need to be user activated by the addition of simple jumper wires. The 'Hold' feature allows a module to extend the dataway cycle. 'Fast Read' shortens the dataway cycle by approximately 50%.

Ref. Jorway Corporation

LAM Grader-Sorter

The model 75 LAM Grader-Sorter not only 'grades' the Dataway L signals but also identifies their locations by means of a two step search. For multicrate systems with numerous L sources, the time necessary to perform a LAM search is significantly reduced over other search methods.

In the simplest mode, grading is accomplished on an internal plug-in patchboard which allows L's to be grouped (Or'ed), and their priorities reordered. Individual GL bits may be masked by a 24-bit addressable register. Resulting GL data is continuously presented to the rear panel connector which connects to the LAG connector of a Type A(A-1) controller.

The two-step search, in addition to grading, implements the LAM search which identifies the

Crate and Station Numbers of the LAM demands. In step 1, a command to the Model 75 produces a GL pattern which identifies the addresses of those crates containing one or more LAM's. A second command, addressed to any crate found in step 1 produces a GL pattern which gives the geographical location (N's) of all LAM's in the crate.

The Model 75 also has front panel provision for external LAM's to be introduced, stored in status registers, and cleared on command. The external LAM signals may be patched into the GL pattern along with internal L signals, and are also available as outputs for use by other devices. X responses are generated for commands accepted.

Ref. Jorway Corporation

Differential-Mode Branch Highway Extender

The model 55 Differential Branch Extender converts standard EUR 4600 Branch Highway signals into differential signals for transmission via long twisted pair cables. The cable is terminated by another model 55 unit that converts the signals back to Branch Highway standards. The result is a branch highway that may be several thousand feet in length. The model 55 units at both ends of the extended branch are identical; neither is committed to be a transmitter or receiver but automatically assumes the appropriate function. Therefore a branch driver may be located at each end of the extended branch highway, each having access to the entire system of crates. For example, a branch display such as the Jorway 72A may be located at a point remote from the computer.

The model 55 has been designed so that it is possible to isolate the ground of the attached EUR 4600 Branch Highway from any circuits of the differential transmission system. This feature prevents ground potential differences, existing between the separate crate systems, exceeding the rather low common mode limitations of conventional semiconductor line receivers and drivers. For this reason a separate power supply is provided for the differential transmission system, and the model 55 is packaged in a standard 19 inch rack mounting unit with self contained power supplies, rather than in a CAMAC module.

Ref. Jorway Corporation

TEST EQUIPMENT

Dataway Related Testers and Displays

CAMAC Dataway Test and Display Module

During the initial testing or rectification of a CAMAC system, an error is much easier to identify if it is possible to store the command and the read or write information from the Dataway. This CAMAC Dataway Test and Display Module type LEM 52/16.2, manufactured under licence from GKF Karlsruhe, can be manually set to store this information, on the Dataway, during either S1 or S2 on three separate registers. The contents of any one of these registers can be displayed on 24 LED's on the front-panel by switch selection.

Again, by switch selection, the module can operate in one of two modes, 'addressed' and 'unaddressed'. In the 'unaddressed' mode, it stores all information available on the Dataway as described above. In the 'addressed' mode, it will only store the information when addressed by the appropriate station number N, and thus can be used to substitute for a module under test.

A LAM can be generated with a front-panel pushbutton, for testing with F(8), and can be cleared with F(10) or C, Z.

Ref. Eisenmann Elektronische Geräte

Index to Manufacturer's News and New Products

PAPER ABSTRACTS TRANSLATIONS

Computer Controlled Measurements of Semiconductor Devices
P. Abend, H. Becker, D. Bräunig, R. Bublitz, G. Herdam, A. Spenker, H.-G. Wagemann and W. Wawer

Zusammenfassung
Ein rechnergeführtes On-Line-Datenverarbeitungssystem mit CAMAC-Instrumentierung wird für vollautomatische Messungen an Halbleiterbauelementen wie Transistoren und Zener-Dioden eingesetzt. Zusätzlich zu der Datenerfassung steuert und überwacht der Rechner die kontinuierliche Meßfolge.

Résumé
Un système de traitement de l'information en ligne commandé par ordinateur et comportant une instrumentation CAMAC est utilisé pour effectuer des mesures entièrement automatiques sur des composants semi-conducteurs tels que transistors et diodes Zener. Outre l'acquisition de données, l'ordinateur contrôle et commande la séquence des mesures effectuées en permanence.

Riassunto
Un sistema per il trattamento di dati on-line mediante calcolatore munito di strumentazione CAMAC viene impiegato per misure completamente automatiche su semiconduttori, come transistor e diodi Zener. Oltre all'ottenimento dei dati il calcolatore controlla e monitorizza la sequenza di misurazione continua.

Samenvatting
Een computer bestuurd on-line dataverwerkingssysteem met CAMAC-instrumentatie wordt gebruikt voor volautomatische metingen aan halfgeleidersystemen zoals transistors en Zenerdioden. De computer verzamelt niet alleen de gegevens maar controleert en stuurt tevens de volgorde van de metingen.

Резюме
Систему обработки данных вместе с оборудованием CAMAC использовано для полной автоматизации измерений параметров полупроводниковых приборов таких как транзисторы и диоды Зенера. Кроме собирания данных ЦВМ непрерывно управляет измерениями и мониторами.

A Remote Hybrid Terminal for Pathology Laboratories
C. J. White

Zusammenfassung
Es handelt sich um eine CAMAC-Datenstation, mit nur einem Rahmen einschießlich einer programmierte Datenwegsteuerung, und um eine modifizierte Fernschreibersteuerung mit einer Übertragungsgeschwindigkeit von 2400 Baud, die Laborinstrumente und Fernschreiber (Teletype) mit einem ortsfernen Rechner verbindet. Sie kann 40 Hybridbefehle und Antworten pro Sekunde übertragen. Die Software für die Steuerung der Datenstation mit einem modularen Einadreß-Rechner ist geschrieben worden.

Résumé
Un terminal CAMAC monochâssis, comprenant un contrôleur de châssis programmé et une commande télétype modifiée pour fonctionner à 2.400 bauds, relie les instruments et les télétypes d'un laboratoire à un ordinateur éloigné. Il peut transférer 40 ordres hybrides et réponses par seconde. Le software a été écrit pour commander le terminal à partir d'un calculateur « Modular One ».

Riassunto
Un terminale CAMAC in contenitore singolo, comprendente un modulo di controllo programmato e un'unità di comando Teletype modificata operante alla velocità di 2.400 bauds, interfaccia gli strumenti di laboratorio e le teletype ad un calcolatore remoto. Il terminale può trasmettere 40 comandi ibridi e risposte per secondo. È stato compilato un software per pilotare il terminale mediante un calcolatore Modular One.

Samenvatting
Een CAMAC terminal met één rek, een geprogrammeerde Dataway regelaar en een gewijzigde Teletype aandrijfelement dat werkt bij 2400 Baud, dient als interface tussen de laboratoriumapparatuur en de verreschrijvers en een op afstand opgestelde computer. Het is in staat om 40 hybride opdrachten en antwoorden per seconde over te brengen. Software werd ontwikkeld voor het aandrijven van de terminal door een Modular One computer.

Резюме
Одно-крейтный терминаль CAMAC содержащий программированный контроллер и модифицированный блок управления телетайпом работающий со скоростью 2400 бодов соединяет лабораторное оборудование с отдаленной ЦВМ. Можно передавать 40 гибридных команд и ответов в секунду. Разработано программы для управления терминаля компутером «Modular One».

MEDAC-CAMAC-A CAMAC System for Medical Data Acquisition and Control
William K. B. Sie and John N. T. Potvin

Zusammenfassung
Ein CAMAC-System verbindet im Echtzeit- und On-Line-Betrieb medizinische Experimente in ortsfernen Laboratorien mit einem Sigma-5-Rechner. Zusätzlich zu einem normalen Branch Highway ist ein Zweiphasen-Branch Highway für ortsferne Rahmen vorhanden. Die Leistung des Systems wird durch den Einsatz von Kleinrechnern gesteigert, die mit hoher Geschwindigkeit arbeiten und als autonome lokale Kontrolleinheiten und Puffer dienen.

Résumé
Un système CAMAC relie, en temps réel, un ordinateur sigma-5 à des expériences médicales effectuées dans des laboratoires éloignés. Outre une interconnexion de branche normale, on utilise une interconnexion de branche à deux phases pour des châssis éloignés. Le système est complété par des mini-ordinateurs utilisés en contrôleurs autonomes rapides et en mémoires tampons.

Riassunto
Un sistema CAMAC collega esperimenti medici in tempo reale e in linea svolti in laboratori remoti a un calcolatore Sigma-5. Oltre ad un normale collegamento del Ramo Principale esiste un Ramo Principale bifase per i contenitori distanti. L'efficienza del sistema è migliorata con l'impiego di mini-calcolatori impiegati come elementi di controllo autonomo locale ad alta velocità e come tamponi.

Samenvatting
Een CAMAC-systeem verbindt onvertraagde en on-line medische experimenten in op afstand gelegen laboratoria met een Sigma-5 computer. Naast een normale Branch Highway is er een tweefasige Branch Highway voor op afstand opgestelde rekken. Het systeem is uitgebreid met mini-computers die worden gebruikt als plaatselijke zeer snelle autonome regelaars en buffers.

Резюме
Несколько медицинских экспериментов в отдаленных лабораториях подключено в режиме реального времени к ЦВМ Сигма-5. Кроме нормальной магистрали ветви существует 2-фразная магистраль для удаленых крейтов. Систему вспомагают мини-ЦВМ использованные как локальные, быстродействующие, автономные контроллеры и буферы.

CAMAC in Denmark
Palle Christensen, Per Høy-Christensen and L. Munkøe

Zusammenfassung
Der Einsatz von CAMAC-Systemen in vier dänischen Instituten wird beschrieben.

Résumé
Description des activités CAMAC dans quatre instituts danois.

Riassunto
Vengono descritte le attività CAMAC svolte in quattro istituti danesi.

Samenvatting
Er wordt een beschrijving gegeven van de werkzaamheden betreffende CAMAC bij vier Deense instituten.

Резюме
Описана деятельность в области CAMAC четырех датских институтов.

A Universal CAMAC Branch Highway Interface for PDP-11
P. Reisser

Zusammenfassung
Dieser Branch Highway Controller kann 16-Bit- oder 24-Bit-Daten mittels Programmsteuerung oder DMA zwischen jeder peripheren CAMAC-Einheit und dem PDP-11 übertragen. Zur schnellen LAM-Verarbeitung zeigt jedes LAM-Signal unmittelbar zu seinem eigenen Unterprogramm oder setzt die geeignete DMA-Übertragung in Gang. Gleichzeitige DMA-Übertragungen sind zwischen 16 Modulen und dem Rechner möglich.

Résumé
Cette commande de branche peut assurer le transfert de données de 16 ou 24 bits entre tout périphérique CAMAC et les canaux programmés ou DMA du PDP-11. Pour accélérer le traitement des LAM, chaque appel pointe directement son propre sous-programme ou initialise le transfert DMA approprié. Des transferts DMA entrelacés sont possibles entre 16 tiroirs et l'ordinateur.

Riassunto
L'unità di controllo del collegamento del Ramo Principale può operare il trasferimento di dati da 16 o 24 bit fra qualsiasi unità periferica CAMAC ed il PDP-11, tramite controllo di programma o accesso diretto alla memoria (DMA). Per rendere più rapido il trattamento LAM ciascun LAM rinvia direttamente alla sua propria subroutine o aziona l'opportuno trasferimento in DMA. È possibile effettuare trasferimenti concorrenti in DMA fra 16 moduli ed il calcolatore.

Samenvatting
Deze Branch Highway regelaar kan 16 bit of 24 bit gegevens overbrengen tussen een willekeurige CAMAC periferie-eenheid en de PDP-11 door programmacontrole of DMA. Voor snelle LAM-verwerking wijst elke LAM direct naar zijn onderprogramma of brengt de passende DMA transmissie op gang. Gelijktijdige DMA transmissie is mogelijk tussen 16 modulen en de computer.

Резюме
Описанный контроллер ветви осуществляет передачу 16- или 24-битовых данных между блоками CAMAC и ЦВМ ПДП-11 путем либо программного управления либо прямого доступа. С целью быстрого обслуживания, каждый запрос LAM связывается с отдельной подпрограммой или

вызывает передачу по прямому доступу. Возможны очередные передачи между 16 блоками и ЦВМ.

An Efficient CAMAC Single-Crate Controller for PDP-8/E
G. Hellmann and J. G. Ottes

Zusammenfassung

Diese Rahmensteuerung verbindet den 24-Bit-CAMAC Datenweg mit dem Omnibus eines PDP-8/E-Rechners. Sie gestattet programmierte Übertragungen von Einzelwörtern, Blockübertragungen sowie LAM-Verarbeitung mit automatischer Vorrangsteuerung und schnellem Zugriff zu Unterprogrammen. Einzyklus-Direktzugriff zum Speicher mit Möglichkeiten 'Add one to memory' und 'Add to memory' ist vorgesehen.

Résumé

Ce contrôleur de châssis relie l'Interconnexion CAMAC 24 bits au bus d'un ordinateur PDP-8/E. Il permet les transferts programmés en un seul mot, les transferts de blocs, et le traitement des appels; le circuit de priorité interne permet un accès rapide aux sous-programmes. L'accès direct mémoire est effectué en 1 cycle avec '+1 Mémoire' ou 'Addition mémoire' automatique.

Riassunto

Questo modulo di controllo interfaccia l'Interconnessione CAMAC da 24 bit all'Omnibus di un calcolatore PDP-8/E. Esso consente trasferimenti programmati per singole parole, trasferimenti a blocchi e trattamenti dei LAM a priorità incorporata e accesso veloce alle subroutine. Esiste la possibilità di un accesso diretto alla memoria a ciclo singolo, con le sub-operazioni 'Add one to memory' e 'Add to memory'.

Samenvatting

Deze rekregelaar dient als interface tussen de 24 bit CAMAC Dataway en de omnibus van een PDP-8/E computer. Hij maakt geprogrammeerde overbrenging mogelijk van een enkel woord, evenals blokoverbrenging en LAM verwerking met prioriteitsprogramma en snelle toegang tot onderprogramma's. Er is een directe toegang tot het geheugen (een machine slag) met 'Add one to memory' en 'Add to memory' onderprogramma's.

Резюме

Описанный контроллер крейта является интерфейсом между 24-битовой магистралью CAMAC и магистралью «Омнибус» компутера ПДП-8Е. Он выполняет программную передачу отдельных слов, блочную передачу и обработку запросов LAM с учетом приоритета и быстрым доступом к подпрограммам. Имеется одно-циклический прямой доступ к памяти с отдельными режимами: добавления до памяти и добавления 1 до памяти.

CAMAC Data Transmission System for Computer-to-Computer Communication
L. Babiloni, E. de Agostino and B. Rispoli

Zusammenfassung

Die zentrale Schnittstelle dieser Datenübertragungsverbindung zwischen einem Zentralrechner und ortsfernen Prozessoren wird durch einen CAMAC-Multiplexer gebildet. Ein LAM-Grader und die programmierte Datenwegsteuerung organisieren eine FIFO-Warteschlange (first in, first out) von Aufrufen der ortsfernen Prozessoren. Für parallele Datenfernübertragungen werden ein symmetrischer Steuer-Empfänger-Modul und verdrillte Leiterpaare benutzt.

Résumé

Dans cette liaison pour transmission de données entre un ordinateur central et des processeurs éloignés, l'interface central est constitué par un système multiplexeur CAMAC. Un tiroir de traitement des appels et un contrôleur d'Interconnexion programmé organisent une file d'attente FIFO pour les appels émis par les processeurs. Les transferts de données parallèles à longue distance sont assurés par un tiroir émetteur-récepteur en signaux symétriques et des lignes bifilaires torsadées.

Riassunto

In questo collegamento di dati tra un calcolatore centrale e i calcolatori remoti l'interfaccia centrale è un sistema multiplexer CAMAC. Un condizionatore dei richiami (Lam-Grader) e un modulo di controllo programmato per l'Interconnessione organizzano la sequenza FIFO per le chiamate dei calcolatori remoti. Trasferimenti in parallelo di dati a lunga distanza usano un modulo ricetrasmittente bilanciato e collegamenti con coppie telefoniche.

Samenvatting

In deze gegevensverbinding tussen een centrale computer en op afstand opgestelde verwerkingssystemen bestaat de centrale interface uit een CAMAC multiplexsysteem. Een LAM sorteerder en een geprogrammeerde dataway regelaar brengen een FIFO wachtrij van aanroepen van de verwerkingssystemen tot stand. Voor de parallelle overbrenging van gegevens over lange afstand wordt gebruik gemaakt van een gebalanceerd zender-ontvangermoduul en getwiste draden.

Резюме

В описаной системе связи между центральной ЦВМ и отдаленными процессорами главным интерфейсом является мультиплексовный состав CAMAC. Програмный контроллер вместе с селекторами LAM организует обслуживание запросов согласно очереди их прихода. Для параллельной передачи данных на большое расстояние применяются балансированные драйверы и приемники как и линии передачи из скрученых пар.

CAMAC Modules for Multi-Detector Bi-Parameter Measurements
G. Durcansky and D. Glasenapp

Zusammenfassung

Drei Typen von CAMAC-Module sind entwickelt worden: ein Acht-Kanal-Vorzähler mit Codier-Einheit, ein Zeitgeber für Flugzeitmessungen und eine Bit-Verarbeitungseinheit. In Verbindung mit einem Rechner werden diese Module für Messungen der Flugzeit subthermischer Neutronen, für Impulshöhenanalyse, Spektrometrie, Messungen des Mössbauer-Effekts und Untersuchungen über die Neutronenstreuung in Abhängingkeit von der Probenposition eingesetzt.

Résumé

Trois types de modules CAMAC ont été développés: un codeur à précompte huit canaux, une horloge temps de vol, et une unité de traitement des bits. Ces modules sont utilisés, avec un ordinateur, pour des mesures de temps de vol des neutrons subthermiques, l'analyse d'amplitude des impulsions, la spectrométrie, les mesures d'effet Moessbauer et la diffusion neutronique par des échantillons.

Riassunto

Sono stati sviluppati tre tipi di moduli CAMAC: un codificatore preconteggiatore a 8 canali, un temporizzatore di tempo di volo ed un'unità per il trattamento dei bit, che vengono collegati a un calcolatore per la misura del tempo di volo di neutroni sub-termici, per l'analisi dell'ampiezza degli impulsi, per la spettrometria, come pure per misure dell'effetto Moessbauer e della dispersione neutronica in relazione alla posizione del campione.

Samenvatting

Drie typen van CAMAC moduul werden ontwikkeld: een 8-kanaals voorgeschakelde teller-codeur, een looptijdklok en een bitverwerkingseenheid. Zij worden, tezamen met een computer, gebruikt voor metingen van de looptijd van subthermische neutronen, pulshoogteanalyse, spectrometrie, Moessbauermetingen en neutronenverstrooiing als functie van de positie van het monster.

Резюме

Разработано три типа блоков CAMAC: 8-канальный предсчетчик — кодер, часы времени пролета и блок манипуляции битами. Они используются вместе с ЦВМ для измерений времени пролета субтермических нейтронов, для амплитудного анализа, спектрометрии, Мессбауеровских измерений и исследований рассеяния нейтронов, зависимого от положения образца.

A Modular Method of Multiplexing Program Sources to Branch Drivers in CAMAC Systems
N. V. Toy, D. M. Drury, and K. R. E. Smith

Zusammenfassung

Mit Systemrahmen (oder Master Crate) arbeitende Methoden zum Aufbau modularer CAMAC-Zentralsteuerungen sind in einer Reihe von Fällen mit ausgezeichneten Ergebnissen angewandt worden. Eine dieser Methoden wird beschrieben. Sie liefert ein CAMAC-substandard-System, das zur Herstellung zentraler Steuerungen für einen weiten Bereich komplexer Erfordernisse eingesetzt werden kann.

Résumé

Plusieurs organismes ont utilisé, avec d'excellents résultats, des méthodes 'châssis système' (ou châssis maître) pour la construction de contrôleurs de systèmes CAMAC modulaires. L'auteur décrit une version de cette approche. On obtient ainsi un sous-standard CAMAC qui peut être utilisé pour construire des contrôleurs de système couvrant un large éventail de cas complexes.

Riassunto

Metodi basati sull'utilizzazione di un contenitore di controllo del sistema contenente moduli per il controllo generale sono stati utilizzati in numerosi impianti con eccellenti risultati. Si descrive un esempio di tale applicazione nella quale un substandard CAMAC può essere utilizzato per costruire unità di controllo del sistema con vari gradi di complessità.

Samenvatting

System Crate (of Master Crate) methoden voor de constructie van modulaire CAMAC systeem regelaars werden met gunstige resultaten toegepast door verschillende instellingen. Er wordt een beschrijving gegeven van een versie van dit concept. Hierdoor komt een CAMAC substandaard tot stand die kan worden gebruikt voor de constructie van systeemregelaars van zeer verschillende ingewikkeldheid.

Резюме

Метод системного крейта (или мастер-крейта) был успешно применен несколькими потребителями при конструировании модульных контроллеров систем CAMAC.

Тут описано версию которая является суб-стандартом CAMAC и может быть использована при конструировании контроллеров систем о различных степенях сложности.

An Extended Basic Language for CAMAC Programming
I. Bals and E. de Agostino

Zusammenfassung

Diese zusammengesetzte Programmiersprache ist aus der hochentwickelten Sprache BASIC mit Assembler-Unterprogrammen aufgebaut. Sie ist zur Verwendung von CAMAC-Hardware in Verbindung mit einem PDP-11-

Rechner bestimmt. Vier Arten der Blockübertragung sind entwickelt worden. Unterprogramme zur Handhabung der von den Modulen geforderten Unterbrechungen (Interrupts) können in BASIC geschrieben werden.

Résumé

Ce langage de programmation mixte comprend le langage évalué BASIC et des sous-programmes en langage assembleur. Il est destiné à être utilisé sur un ordinateur PDP-11 connecté à CAMAC. Quatre modes de transfert de blocs ont été réalisés. Les sous-programmes de traitement des interruptions émises par les modules peuvent être écrits en BASIC.

Riassunto

Questo linguaggio di programmazione mista comprende un linguaggio BASIC ad alto livello, con delle 'subroutine' in un linguaggio assembler e subroutine. È destinato ad essere impiegato con il CAMAC su un calcolatore PDP-11. Sono stati sperimentati quattro tipi di trasferimento a blocchi. Le subroutine per le interruzioni effettuate dai moduli possono essere scritte in BASIC.

Samenvatting

Deze gecombineerde programmeertaal omvat de BASIC geavanceerde programmeertaal met machine taal onder programma's. Zij is bedoeld voor gebruik met CAMAC, gekoppeld aan een PDP-11 computer. Er is voorzien in vier wijzen van bloktransport. Onderprogramma's voor het behandelen van ingrepen van modules kunnen worden uitgewerkt in BASIC.

Резюме

Описанный комплексный язык программирования состоит из языка высшего уровня БАЗИК и подпрограмм языка ассемблера. Он предназначен для системы CAMAC при соединении ЦВМ ПДП-11. Осуществлено 4 режима блочной передачи. Подпрограммы для обслуживания прерываний от блоков могут быть написаны на языке БАЗИК.

COMP11, a CAMAC-Oriented Monitor for the PDP-11

Ronald M. Keyser

Zusammenfassung

Es wird ein Monitorprogramm für die PDP-11 beschrieben, mit dem CAMAC-ähnliche Befehle ausgeführt werden können, welche über einen Blattschreiber eingegeben werden. Für die wiederholte Ausführung eines Befehlssatzes steht ein "Stored Programme Mode" zur Verfügung. Ungültige Kodierungen werden vom Monitor automatisch zurückgewiesen.

Résumé

On décrit un programme moniteur PDP-11, qui accepte et exécute les ordres CAMAC provenant de la télétype. Ce moniteur est écrit en PAL-11 et comprend un mode permettant de mémoriser une séquence d'ordres CAMAC dont l'exécution peut être répétée. Le moniteur refuse automatiquement les codes invalides.

Riassunto

Il programma monitor per il PDP-11 descritto dall'articolo accetta ed esegue istruzioni di tipo CAMAC dalla telescrivente. Il monitor è compilato in linguaggio PAL-11. Il sistema può funzionare a programma memorizzato per l'esecuzione ripetuta di un gruppo di istruzioni. Il monitor respinge automaticamente i codici non validi.

Samenvatting

Een beschrijving wordt gegeven van een monitorprogramma voor de PDP-11 waarmee opdrachten van het CAMAC-type via de telex kunnen worden opgenomen en uitgevoerd. De monitor is geschreven in PAL-11. Voor de herhaalde uitvoering van een serie opdrachten is voorzien in een werkwijze welke door een geheugen wordt geprogrammeerd. Ongeldige codes worden automatisch door de monitor verworpen.

Резюме

Описано программу монитор для ЭВМ PDP-11 которая принимает команды KAMAK из телетайпа и выполняет их. Монитор написано на языке PAL 11. Повторяющиется последовательности команд могут быть накоплены. Монитор автоматически отбрасывает ошибочные коды.

CONCO – A CAMAC Language Assembler

M. P. H. Davies, P. J. Hagan and R. A. Hunt

Zusammenfassung

Der auf einem PDP-10-Rechner laufende Assembler CONCO verarbeitet eine geeignete Programmiersprache für die Datenwegsteuerung 7025 von Nuclear Enterprises und druckt eine Diodenstift-Anordnung für den Programmspeicher der Stecktafel der Steuereinheit aus. Er steigert die Effizienz autonomer CAMAC-Systeme mit einem Rahmen (und Fernschreiber) sowie von Systemen, die mit dem PDP-10-Rechner gekoppelt sind.

Résumé

Cet assembleur, utilisé sur un calculateur PDP-10, accepte un langage de programmation pratique pour le contrôleur de châssis Nuclear Enterprises 7025. Il fournit l'implantation des diodes de la matrice mémoire programme du contrleôur. Il met en valeur les qualités des systèmes autonomes CAMAC monochâssis (avec télétypes) ou des systèmes couplés au PDP-10.

Riassunto

L'assembler, che viene impiegato su un calcolatore PDP-10, accetta un linguaggio di programmazione adatto per il 'Dataway Controller' tipo 7025 della Nuclear Enterprises, e stampa uno schema dei terminali dei diodi per il pannello di connessioni di programma. In questo modo si aumentano le possibilità d'impiego dei sistemi CAMAC a contenitore singolo autosufficienti (con Teletype) e dei sistemi accoppiati al PDP-10.

Samenvatting

Dit vertaalprogramma voor een PDP-10 computer verwerkt de gemakkelijke programmeertaal van de Nuclear Enterprises 7025 Dataway Controller en drukt de plaatsing af van de diodestekers van het stekerbord van het programmageheugen. Het verhoogt de levensduur van losse standaardrekken van het CAMAC-systeem (met verreschrijver) of van aan de PDP-10 gekoppelde systemen.

Резюме

Выполняемая компутером ПДП-10 программа ассемблер принимает язык программирования контроллера типа 7025 (Nuclear Enterprises) и выдает однечатанный вид расположения диодов на плате памяти программы контроллера. Она повышает полезность одно-крейтных самостоятельных составов CAMAC или составов сопряженных с ПДП-10.

A Standard Format for CAMAC Device Specifications

J.-B. Bossel and H. Klessmann

Zusammenfassung

Es wurde ein einheitliches Format zur Beschreibung der Hardware- und Software-Eigenschaften von CAMAC-Geräten entworfen, um den Aufbau und die Programmierung der Systeme zu erleichtern. Die für alle Geräte angelegten Formblätter (ein Blatt pro Gerät) mit den technischen Charakteristiken ergeben einen Katalog der CAMAC Instrumentierung.

Résumé

Un format standard de présentation des caractéristiques hardware et software des matériels CAMAC a été conçu pour faciliter l'élaboration et la programmation de systèmes. Les caractéristiques de chaque appareil sont enregistrées sur un formulaire qui peut être utilisé comme page de fichier ou catalogue d'instrumentation CAMAC.

Riassunto

È stato progettato un formato standard per la presentazione delle caratteristiche di hardware e di software delle attrezzature CAMAC in modo da facilitare la messa in opera dei sistemi e la programmazione. Le caratteristiche di ciascun dispositivo vengono registrate in forma tale da poter essere impiegato come una pagina di un catalogo o di un registro della strumentazione CAMAC.

Samenvatting

Standaardformaten voor het vastleggen van de specificaties van hardware en software van CAMAC modules werd ontworpen als hulpmiddel voor de opbouw en de programmering van systemen. De karakteristieken van de verschillende eenheden zijn geregistreerd op een formulier dat kan worden gebruikt als bladzijde van een CAMAC instrumentatie archief of catalogus.

Резюме

Предложена стандартная форма представления электронных и программных характеристик оборудования CAMAC с целью облегчения работы при проектировании составов аппаратуры и программ. Характеристики любого прибора записывают на бланке который можно включить как одну карту в каталог аппаратуры CAMAC.

Decimal Classification of CAMAC Instrumentation

O. Ph. Nicolaysen

Zusammenfassung

Ein Schema einer Dezimalklassifikation für CAMAC-Instrumentierung wird beschrieben. Es soll von Heft 7 an im CAMAC-Bulletin anstelle des bisherigen Schemas für die mittels Computer erstellte Übersicht über die neuen Produkte benutzt werden. Dieses Schema könnte so erweitert werden, daß die Einbeziehung der Software und allgemeiner Themen im Zusammenhang mit CAMAC möglich ist.

Résumé

L'auteur décrit un plan de classification décimale pour instrumentation CAMAC, qui remplacera, à partir du bulletin CAMAC N° 7, la classification précédente, de la liste guide des produits, réalisée sur calculateur. Cette méthode pourrait être étendue au software et aux sujets d'ordre général en rapport avec CAMAC.

Riassunto

Si descrive uno schema di classificazione decimale per la strumentazione CAMAC, che verrà impiegato al posto del sistema precedente per la compilazione su calcolatore della Guida dei prodotti del Bollettino CAMAC a partire dal n. 7. Lo schema potrà essere ampliato in modo da comprendere il software e argomenti di natura generale connessi con il CAMAC.

Samenvatting

Er wordt een beschrijving gegeven van een decimaal classificatiesysteem voor CAMAC instrumentatie. Dit zal in de plaats van een vroeger schema worden gebruikt voor de door middel van een computer samengestelde produktengids in het CAMAC Bulletin en zulks met ingang van n° 7. Het schema zal eventueel worden uitgebreid tot software en algemene onderwerpen in verband met CAMAC.

Резюме

Описано схему десятичной классификации аппаратуры CAMAC, которая будет использована вместо старой версии при составлении справочника по изделиям в бюллетене CAMAC начиная с номера 7. Схема может быть расширена для включения программ и других тем относящихся к CAMACу.

MEMBERSHIP OF THE ESONE COMMITTEE

This list shows the member organisations and their nominated representatives on the ESONE Committee. Members of the Executive Group are indicated thus*.

International	European Organization for Nuclear Research (CERN)	*F. Iselin**	Geneva, Switzerland
	Centro Comune di Ricerca (Euratom)	*L. Stanchi*	Ispra, Italia
	ESONE Secretariat	*W. Becker**	
	Bureau Central de Mesures Nucléaires (Euratom)	*H. Meyer**	Geel, Belgique
	Institut Max von Laue - Paul Langevin	*A. Axmann*	Grenoble, France
Austria	Studiengesellschaft für Atomenergie	*W. Attwenger*	Wien
	Inst. für Elektrotechnische Messkunde an der T.H.	*R. Patzelt**	Wien
Belgium	Centre d'Etude de l'Energie Nucléaire	*L. Binard*	Mol
Denmark	Forsögsanläg Risö	*P. Skaarup*	Roskilde
England	Atomic Energy Research Establishment	*H. Bisby**	Harwell
	Culham Laboratory	*A.J. Vickers*	Abingdon
	Daresbury Nuclear Physics Laboratory	*B. Zacharov*	Warrington
	Rutherford High Energy Laboratory	*M.J. Cawthraw*	Chilton
	University of Oxford	*B.E.F. Macefield*	Oxford
	University of York	*I.C. Pyle*	Heslington
France	Centre d'Etudes Nucléaires de Saclay	*P. Gallice**	Gif-sur-Yvette
	Centre d'Etudes Nucléaires de Grenoble	*J. Lecomte*	Grenoble
	Laboratoire de l'Accélérateur Linéaire	*Ph. Briandet*	Orsay
Germany	Deutsche Studiengruppe für Nukleare Elektronik c/o Physikalisches Institut der Universität	*B.A. Brandt*	Marburg
	Deutsches Elektronen-Synchrotron	*D. Schmidt*	Hamburg
	Hahn-Meitner-Institut für Kernforschung	*H. Klessmann*	Berlin
	Kernforschungsanlage Jülich	*K.D. Müller*	Jülich
	Gesellschaft für Kernforschung	*K. Tradowsky*	Karlsruhe
	Institut für Kernphysik der Universität	*W. Kessel*	Frankfurt/Main
Greece	Demokritus' Nuclear Research Centre	*Ch. Mantakas*	Athens
Hungary	Central Research Institute for Physics	*J. Biri*	Budapest
Italy	Comitato Nazionale Energia Nucleare (CNEN)	*B. Rispoli**	Roma
	CNEN Laboratori Nazionali	*M. Coli*	Frascati
	CNEN Centro Studi Nucleari	*F. Fioroni*	Casaccia
	Centro Studi Nucleari Enrico Fermi	*P.F. Manfredi*	Milano
	Centro Informazioni Studi Esperienze	*P.F. Manfredi*	Milano
	Istituto di Fisica dell'Università	*G. Giannelli*	Bari
Netherlands	Reactor Centrum Nederland	*P.C. van den Berg*	Petten
	Instituut voor Kernphysisch Onderzoek	*E. Kwakkel*	Amsterdam
Poland	Instytut Badan Jadrowych	*R. Trechciński*	Swierk K/Otwocka
Sweden	Aktiebolaget Atomenergi Studsvik	*Per Gunnar Sjölin*	Nyköping
Switzerland	Schweizerische Koordinationstelle für die Zusammenarbeit auf dem Gebiet der Elektronik	*H.R. Hidber*	Basel
Yugoslavia	Boris Kidrič Institute of Nuclear Sciences	*M. Vojinovic*	Vinča Belgrade

Affiliated Laboratory

Canada	TRIUMF Project, University of British Columbia Simon Fraser University, University of Victoria	*W.K. Dawson*	Edmonton

LIAISON WITH THE USAEC NIM COMMITTEE IS MAINTAINED THROUGH:

L. COSTRELL (Chairman), National Bureau of Standards – Washington, DC.

F.A. KIRSTEN (NIM-CAMAC Dataway Working Group), Lawrence-Berkeley Laboratory – Berkeley, California.

S. DHAWAN (NIM-CAMAC Software Working Group), Yale University – New Haven, Connecticut.

D.A. MACK (NIM-CAMAC Mechanics Working Group), Lawrence-Berkeley Laboratory – Berkeley, California.

D.I. PORAT (NIM-CAMAC Analogue Signals Working Group), Stanford Linear Accelerator Center–Stanford, California.

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 taken from a CAMAC Products Reference compiled by CERN-NP-EL II from manufacturers' catalogues, advertisements and written communications available to them on 10th May 1973.

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. Users are advised to obtain detailed information from the manufacturers or their agents in order to check the compatibility and operational characteristics of equipment.

> An important change has been introduced this time. Products are tentatively listed according to a new decimal classification – see below – which, it is hoped, will facilitate the search for products.
>
> Correspondence between old and new classification is given below.
>
> A description of the new classification system can be found in this issue of the Bulletin.

Names of some manufacturers appearing in earlier lists have changed, the appropriate reference is given in the Index of Manufacturers at the end of this guide.

How to search for appropriate class: As a first approach use the relatively coarse classification listed below. In the Index of Products you will find a heading for each three-decimal class. Subclasses within these are denoted by a point and one or two digits, printed for the first item of its class, subclass, etc.

Remarks on some columns in the Index of Products

Column

N/C – N is new, C is corrected entry.

CODE – This is the classification code. It may here have up to five decimals and looks like .1, .12, .123, .123.4, .123.45. The first three decimals may be omitted.

WIDTH – NA indicates other format, normally 19 inch rack mounted chassis.
– 24 or 25 indicates number of stations available in a crate.
– Blank, the width has no meaning.
– 0 indicates unknown width.

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

* During this transition to the new classification there are unfortunately some minor errors of layout which will be corrected in future issues.

OLD CATEGORIES	NEW CLASSES			
SYSTEM UNITS, TEST EQUIPMENT				
Branch Highway Related System Units (Computer Couplers, Crate Controllers, Terminations)	211	22	231	233
Dataway Related System Units (Computer Couplers, Controllers)	213	231	233	
Other System Units	212	214	217	232
	234	27		
Manual Controllers and Test Equipment	3			
I/O REGISTERS, DISPLAYS				
Serial Input Modules (Scalers)	111	112	117	
Preset Counting Modules (Scalers, Timers)	113	114	117	
Parallel Input Registers	122	123	127	142
Parallel Input Gates (Dataway Connecting)	121			
Manual Input Modules	124			
Data Storage Modules	154			
Parallel Output Modules	132	133	137	142
Display Modules and Units	144			
Peripheral Input/Output Modules	143	145	147	
MULTIPLEXERS, CONVERTERS				
Multiplexers	164			
Code Converters	153			
Analogue-to-Digital Converters (ADC, DVM)	161	163		
Digital-to-Analogue Converters (DAC)	162	163		
Time-to-Digital Converters	161			
OTHER MODULES				
Other Analogue and/or Digital Modules	151	152	157	165
	167			
Pulse Generators and Clocks	131			
Logic Function Modules	151	155	157	
Delay and Attenuator Units	157	165		
CRATES, SUPPLIES				
Crates - no Power, no Dataway	417			
Crates - with Dataway, no Power	412			
Crates - with Dataway and Power	411			
Power Supplies and Supply Controls	42			
Ventilation Equipment	417	427		
COMPONENTS				
Extenders and Adapters	341	437		
Module Parts	433			
Dataway Components	432			
Branch Highway Components	431			
Other Standard CAMAC Components	437			

INDEX OF PRODUCTS

NC CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR

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 CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
.14	COUNTING REGISTER (1X24BIT,15MHZ,TTL/NIM SIGNALS,EXT INHIBIT IN,CARRY OUT)	7070-1	NUCL. ENTERPRISES	1	/70	
	ECHELLE BINAIRE 24 BITS(SCALER,20MHZ NIM OR 10MHZ TTL I/P,EXT INHIBIT IN,OVF O/P)	J EB 10	SAIP	1	/71	
.22	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	
.23	DUAL 150 MHZ 16 BIT SCALER (ONE 50 OHMS, ONE UNTERMINATED NIM INPUT PER SCALER)	2S 2024/16	SEN	1	/70	
.24	DUAL 24 BIT BINARY SCALER (15MHZ, NIM OR TTL INPUTS)	FHC 1313	BF VERTRIEB	1	/72	
	DUAL 24-BIT COUNTING REGISTER	C-DS-24	WENZEL ELEKTRONIK	1	/72	
.25	DUAL 100MHZ SCALER (2X24 BIN BITS OR 2X6 BCD DIGITS,DISCR LEVEL -0.5V)	80A	JORWAY	1	/70	(1)
	DUAL 150 MHZ 24 BIT SCALER (ONE 50 OHMS, ONE UNTERMINATED NIM INPUT PER SCALER)	2S 2024/24	SEN	1	/70	
.42	MICROSCALER (4X16BIT,2X32BIT SELECTABLE, 25MHZ,COMMON GATE,NIM LEVELS)	1003	BORER	1	/69	
	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 (4X16BIT,SELECTABLE 2X32BIT, 50MHZ,COMMON GATE,NIM LEVELS, CERN 003)	S416	EG+G	1	/71	
	QUAD 16-BIT SPARK READ-OUT REGISTER (20MHZ RATE,TTL LEVELS)	SR 1604	GEC-ELLIOTT	1	/71	
	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)
	QUAD SCALER	9015	NUCL. ENTERPRISES	0	/71	(5)
	MICROSCALER(4X16BIT,2X32BIT SELECTABLE, 25MHZ,COMMON GATE,NIM LEVELS)	C 102	RDT	1	/71	
	ECHELLE BINAIRE 4 X 16 BITS(SCALER,30MHZ 2X32BIT SELECTABLE,COMMON GATE,NIM/TTL)	J EB 20	SAIP	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)
	QUAD 25 MHZ SCALER (4X16BIT,2X32BIT SELECTABLE,COMMON GATE,NIM LEVELS)	QS-003/25	TECHCAL	1	/71	
.43	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	

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.43	QUAD 100 MHZ SCALER (4X16BIT,2X32BIT SELECTABLE,COMMON GATE,NIM LEVELS)	QS-003/100	TECHCAL	1	/71	
N	.44	QUAD SCALER (4X24BIT, 50MHZ, DATAWAY AND/OR EXT FAST INHIBIT, NIM LEVELS)	S424S	EG+G	1		(7)
		QUAD COUNTING REGISTER(4X24BIT,NIM INPUT TTL INHIBIT IN,TTL CARRY AND OVF OUT)	709-2	NUCL. ENTERPRISES	1	/71	
	.45	QUAD SCALER (4X24BIT,150/125MHZ,DATAWAY AND/OR EXT FAST INHIBIT,NIM LEVELS)	S424B	EG+G	1	/71	
N		QUAD SCALER (4X24BIT, 200MHZ, DATAWAY AND/OR EXT FAST INHIBIT, NIM LEVELS)	S424F	EG+G	1		
C		QUAD SCALER (4X24BIT,WITH CARRY+16/24BIT OUT,100/125MHZ,200MHZ OPTION,NIM SIGNLS)	S1	JOERGER	1	/72	(5)
		QUAD 100MHZ SCALER (4X24BIT,DISCR LEVEL -0.5V,TIME-INTERVAL APPL,NIM INHIB I/P)	84	JORWAY	1	/71	(2)
N	.7	HEX TTL/NIM 50 MHZ SCALER	3610	KINETIC SYSTEMS	1	01/73	
N		HEX NIM 100 MHZ SCALER	3615	KINETIC SYSTEMS	1	04/73	
	.71	OCTAL SCALER (12BITS,8 INPUTS,50MHZ,EACH SCALER GIVES EXT INHIBIT,NIM LEVELS)	S812	EG+G	1	/71	

.112 SIMPLE SERIAL DECADE REGISTERS

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.14	ECHELLE 6 DECADES DCB (DECADE SCALER, 25 MHZ, BUILT-IN DISPLAY)	J EA 20	SAIP	1	04/73	
	.24	DUAL 24 BIT BCD SCALER (15MHZ, NIM OR TTL INPUTS)	FHC 1311	BF VERTRIEB	1	/72	
	.25	DUAL 100 MHZ-6 DECADE BCD SCALER	C 350	INFORMATEK	1	02/73	
		DOUBLE ECHELLE 6 DECADES-100 MHZ A AFFICHAGE REPORTE(SCALER WITH REG O/P)	J EA 10	SAIP	1	/71	
	.44	QUAD SIX-DECADE COUNTER WITH VARIABLE THRESHOLD AND INPUT FILTER, SLOW	1007	BORER	1	/72	(4)
		QUAD BCD SCALER (4X6 DECADES,30MHZ)	9021	NUCL. ENTERPRISES	0	/71	

.113 PRESET SERIAL BINARY REGISTERS

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	.12	16 BIT PRESETTABLE INTERVAL COUNTER	2201	BI RA SYSTEMS	1	04/73	
		PRESET COUNTING REGISTER (16BIT,10MHZ, NIM/TTL I/P,TTL INHIB + O/P,DATAWAY SET)	7039-1	NUCL. ENTERPRISES	1	/70	
N	.14	24 BIT PRESETTABLE INTERVAL COUNTER	2202	BI RA SYSTEMS	1	04/73	
		PRESET SCALER(24BIT,30MHZ,DATAWAY PRESET COUNT/TIME,INPUT GATED,NIM LEVELS)	1001	BORER	1	/71	(1)
		PRESET COUNTING REGISTER (24BIT,10MHZ, DATAWAY SET,NIM/TTL INPUT,TTL O/P+INHIB)	703-1	NUCL. ENTERPRISES	1	/71	
		PRESETTABLE COUNTER (24BIT)	420	POLON	1	10/73	
		SCALER 50 MHZ (12/16/18/24BIT,PRESET WITH OVF LINE,CONSTANT DEADTIME)	C 72451-A3-A1	SIEMENS	1	/72	
		PRESETTABLE SCALER (24BIT)	C-PS-24	WENZEL ELEKTRONIK	1	/72	
	.15	SCALER 300 MHZ (12/16/18/24BIT,PRESET WITH OVF LINE,CONSTANT DEADTIME)	C 72451-A11-A1	SIEMENS	1	/72	
	.25	DOUBLE ECHELLE 24 BITS (PRESET 2X24BIT SCALER, 100 MHZ COUNTING)	J EP 30	SAIP	1	04/73	

.114 PRESET SERIAL DECADE REGISTERS

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.114	REAL TIME CLOCK (3.8 USEC TO 18.2 HRS, PRESET-TIME AND PRESET-COUNT MODES)	RTC 2014	SEN	1	/71	
	.14	24BIT BCD PRESET-SCALER (12MHZ, NIM OR TTL INPUTS,MANUAL OR DATAWAY PRESET)	FHC 1301	BF VERTRIEB	2	/71	(1)
		24BIT BCD PRESET-SCALER (12MHZ, NIM OR TTL INPUTS,DATAWAY PRESET)	FHC 1302	BF VERTRIEB	1	/71	(1)
		ECHELLE 6 DECADES A PRESELECTION(SCALER, MAN/DATAWAY PRESET,1MHZ,START/STOP O/P)	J EP 20	SAIP	2	/71	
	.17	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	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.117	UP/DOWN PRESETTABLE COUNTER(24BIT,25MHZ, GATED,SEPARATE UP/DOWN COUNT INPUTS)	S2	JOERGER	1	/72	(5)
		SEQUENTIAL INPUT REGISTER(16 8BIT BYTES, STORES CODED NIM PULSES,0=40,1=150NSEC)	SIRE	SAIP	1	/71	
		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	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.1	INPUT GATE	320	POLON	1	09/73	
		DYNAMIC DIGITAL INPUT, TTL	C 76451-A17-A1	SIEMENS	0		(6)
		DYNAMIC DIGITAL INPUT, POT. FREE	C 76451-A17-A2	SIEMENS	0		(6)
	.12	SINGLE 16 BIT PARALLEL INPUT GATE (WITH LED DISPLAY OPTION)	PG-601	TECHCAL	1	/72	
	.14	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	
		SINGLE 24 BIT PARALLEL INPUT GATE (WITH LED DISPLAY OPTION)	PG-603	TECHCAL	1	/72	
	.22	DUAL 16 BIT PARALLEL INPUT GATE (WITH LED DISPLAY OPTION)	PG-602	TECHCAL	1	/72	
N	.24	DUAL 24 BIT PARALLEL INPUT GATE (TTL)	2422	BI RA SYSTEMS	1	04/73	
		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		
		DUAL 24 BIT PARALLEL INPUT GATE (WITH LED DISPLAY OPTION)	PG-604	TECHCAL	1	/72	(6)
	.33	PARALLEL INPUT GATE (3X16BIT INPUT FROM ISOLATING CONTACTS)	1061	BORER	1	/72	(4)
		PARALLEL INPUT GATE (3X16BIT INPUT FROM ISOLATING CONTACTS, DYNAMIC INPUTS)	1062	BORER	1		
	.41	DIGITALES EINGANGSREGISTER MIT OPTOKOPP-LER(4X8BIT PARALLEL INPUT GATES,WITH L)	DO 200-2003	DORNIER	1	/72	
		(WITH FRONT PANEL CONNECTOR)	DO 200-2203		1	/72	
	.7	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	03/73	
	.71	DIGITALES EINGANGSREGISTER(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	
		DIGITALES EINGANGSREGISTER(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	

.122 STORING REGISTERS

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.12	PARALLEL-INPUT-REGISTER (SINGLE 16/24BIT OPTION,READY SIGNALS,I/O TTL,ADC APPL)	MS PI 1 1230/1	AEG-TELEFUNKEN	1	/70	(1)
		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	
		DIGITAL INPUT 16 BIT POT. FREE	C 76451-A8-A2	SIEMENS	0		(6)
		STATIC DIGITAL INPUT, TTL	C 76451-A8-A1	SIEMENS	0		(6)
		SINGLE 16 BIT PARALLEL INPUT REGISTER	PR-601	TECHCAL	1	/72	(6)
	.14	INPUT REGISTER (24BIT, SPEC CONN, 8 BIT ALSO VIA LEMO,LAM ON NON-ZERO OR STROBE)	FHC 1308	BF VERTRIEB	1	/71	
		INPUT REGISTER 24-BIT	3470	KINETIC SYSTEMS	1	/71	(4)
		SINGLE 24 BIT PARALLEL INPUT REGISTER (WITH LED DISPLAY OPTION)	PR-603	TECHCAL	1	/72	(6)

V

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.15	BALANCED INPUT REGISTER WITH ADDRESSING	3430	KINETIC SYSTEMS	1	/72	
	.22	DUAL INPUT REGISTER (2X16BIT WITH LAM AND STROBE FOR EACH CHANNEL)	PR 1610 SERIES	GEC-ELLIOTT	1	05/73	
		32 BIT INPUT REGISTER	C 345	INFORMATEK	1	05/73	
		DUAL INPUT REGISTER (2X16BIT)	301	POLON	1	09/73	
		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	
		DUAL 16 BIT INPUT REGISTER(CONTINUOUS, STROBED AND ONE-STROBE DATA ENTRY,TTL)	PR-602	TECHCAL	1	/71	(6)
		DUAL 16 BIT PARALLEL INPUT REGISTER (WITH LED DISPLAY OPTION)	PR-604	TECHCAL	1	/72	
N	.24	DUAL 24 BIT PARALLEL INPUT REGISTER(TTL)	2322	BI RA SYSTEMS	1	04/73	
		DUAL 24 BIT INPUT REGISTER (TTL, HANDSHAKE)	RI-224	EG+G	1	/72	
		DUAL INPUT REGISTER (2X24BIT WITH LAM AND STROBE FOR EACH CHANNEL)	PR 2400 SERIES	GEC-ELLIOTT	1	05/73	
		DUAL PARALLEL INPUT REGISTER(2X24BIT,EXT LOAD REQUEST,4 OPER MODES,TTL LEVELS)	60	JORWAY	1	/70	
C		24-BIT DUAL PARALLEL INPUT REGISTER (A HAS LO-Z, B HAS UNTERMINATED INPUT)	9041A/9041B	NUCL. ENTERPRISES	1	/72	(7)
		DUAL INPUT REGISTER (2X24BIT)	302	POLON	2	09/73	
		PARALLEL INPUT REGISTER (2X24 BITS)	J RE 10	SAIP	1	04/73	(7)
	.42	INPUT READER (4X16BIT OR 64 BITS, TTL, 1=LOW, CONNECTORS OPTIONAL)	151	WALLAC	1		
	.44	INPUT READER (4X24BIT OR 96 BITS, TTL, 1=LOW, CONNECTORS OPTIONAL)	152	WALLAC	1		
	.71	DIGITALES EINGANGSREGISTER, EXT STROBE (4X8BIT INPUT LATCHES, 1X8BIT SET LAM)	DO 200-2004	DORNIER	1	04/73	
		(SAME WITH FRONT PANEL CONNECTOR)	DO 200-2204		1	04/73	
	.72	INPUT READER (8X16BIT OR 128 BITS, TTL, 1=LOW, CONNECTORS OPTIONAL)	153	WALLAC	1		
		(SAME BUT WITH 8X24BIT OR 192 BITS)	154		1		
		(SAME BUT WITH 16X8BIT OR 128 BITS)	155		1		
		(SAME BUT WITH 16X16BIT OR 256 BITS)	156		1		

.123 TERMINATED SIGNAL INPUT REGISTERS (COINC. LATCH, PATTERN ETC)

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.123	COINCIDENCE LATCH (24 NIM INPUTS WITH COMMON STROBE, EXT RESET, 2NSEC OVERLAP)	C124	EG+G	2		
N	.11	12 BIT PARALLEL INPUT REGISTER (NIM)	2351	BI RA SYSTEMS	1	04/73	
		STROBED INPUT REGISTER (12BIT COINC AND LATCH,NIM LEVELS,PATTERN AND L-REQ APPL)	SIR 2026	SEN	1	/70	
	.12	FAST COINCIDENCE LATCH(16BIT,DISCR I/P, MIN 2 NSEC STROBE-SIGNAL OVERLAP)	64	JORWAY	1	/71	(1)
N		16 NIM INPUT REGISTER AND DISCRIMINATORS	3440	KINETIC SYSTEMS	1	04/73	
N		16 NIM INPUT REGISTER	3441	KINETIC SYSTEMS	1	04/73	
		16 FOLD DCR(I/P DISCR,STROBE-INPUT OVER-LAP 2NSEC,CH1-8 AND CH9-16 SUM O/P,NIM)	2340B	LRS-LECROY	2	/71	(6)
		16-CH COINCIDENCE REGISTER (16 CHANNELS, STROBE-INPUT OVERLAP 2NSEC,NIM LEVELS)	2341	LRS-LECROY	2	/71	(4)
		PATTERN UNIT (16 INDIV NIM INPUTS,COMMON NIM GATE)	021	NUCL. ENTERPRISES	2	/71	(5)
		PATTERN UNIT(16BIT,I/P STROBED WITH COMMON GATE,10 NSEC OVERLAP,NIM LEVELS)	C 101	RDT	2	/71	
		REGISTRE DE CONFIGURATION (16 BIT PATTERN UNIT, NIM I/P AND GATE)	J PU 10	SAIP	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 SPECS 071, 16 INDIVIDUAL NIM INPUTS,COMMON NIM GATE)	16P 2047	SEN	1	/72	(6)
	.21	COINCIDENCE BUFFER (2X12BIT,ONE STROBE PER 12BITS,MIN 2NS OVERLAP,NIM INPUTS)	C212	EG+G	2	/71	
	.22	DUAL 16 BIT FAST LATCH(FAST NIM/ECL I/P, STROBE FOR EACH CHANNEL, 6 NSEC OVERLAP)	PR 1605	GEC-ELLIOTT	1	05/73	

NC CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
.124	MANUAL INPUT MODULES (WORD GENERATORS, PARAMETER UNITS)					
.11	PARAMETER UNIT 12 BIT (PROVIDES 12 BIT COMMUNICATION,PUSH BUTTON L-REQUEST)	P 2005	SEN	1	/70	
.12	DATA SWITCHES (16/24 BITS,READABLE + CONTENT ADDR)	C 322	INFORMATEK	1	/72	
	16 BIT WORD GENERATOR	WGR-160	TECHCAL	1	/72	
.14	WORD GENERATOR (24BIT WORD MANUALLY SET BY SWITCHES)	WG 2401	GEC-ELLIOTT	1	/71	
	WORD GENERATOR (24 BITS OF BINARY DATA, SWITCH SELECTED)	9020	NUCL. ENTERPRISES	1	/71	(2)
	24 BIT WORD GENERATOR	WGR-240	TECHCAL	1	/72	
.43	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 LAM GRADER)					
.127	24-BIT INTERRUPT REGISTER (STATUS COMPARED,CHANGE GIVES LAM)	1051	BORER	1	/72	(3)
	PRIORITY INPUT REGISTER(12BITS ORED TO LAM,FAST COINC LATCH APPL,NIM LEVELS)	63	JORWAY	2	/70	
	PRIORITY INTERRUPT REGISTER 16 BIT	3475	KINETIC SYSTEMS	1		
	INTERRUPT REQUEST REGISTER	EC 218	NUCL. ENTERPRISES	0		
	INTERRUPT REQUEST REGISTER (8BIT, TTL INPUTS TO REGISTER,ANY INPUT GIVES LAM.	7013-1	NUCL. ENTERPRISES	1	/70	
	REQUIRE REGISTER	300	POLON	1		
.13	DIGITAL OUTPUT MODULES --SERIAL: CLOCKS,TIMERS, PULSE GENERATORS, PARALLEL: TTL OUTPUT,DRIVERS					
.131	SERIAL OUTPUT MODULES (CLOCKS, TIMERS, PULSE GEN)					
.1	CRYSTAL CLOCK GENERATOR (7 TTL OUTPUTS FOR 1HZ TO 1MHZ FREQUENCY DECADES)	FHC 1303	BF VERTRIEB	1	/71	(1)
	CLOCK/TIMER (0.001S TO 10 HRS TIME INTERVAL,REAL-TIME OUTPUT)	1411	BORER	1	/72	(3)
	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)
	REAL TIME CLOCK (COUNTS .1 SEC TO 999 DAYS, DISPLAYS HRS/MIN/SEC, 50/60HZ GEN)	RTC	JOERGER	2	01/73	(7)
	REAL TIME CLOCK (NEEDS EXT CLOCK,MAX 100 DAYS PERIOD WITH 1HZ PULSES IN,TTL I/O)	712	NUCL. ENTERPRISES	1	/71	
	CLOCK PULSE GENERATOR (7 OUTPUTS-1HZ TO 1MHZ-IN DECADE STEPS,10MHZ EXT IN,TTL)	7019-1	NUCL. ENTERPRISES	1	/70	
	CLOCK PULSE GENERATOR	730	POLON	1	10/73	
	ASTRONOMICAL TIME CLOCK	731	POLON	1	11/73	
	QUARZ CLOCK		POLON	0	10/73	
	CLOCK PULSE GENERATOR(7 DECADES-1HZ TO 1MHZ-500 NSEC PULSES OUT,TTL AND NIM)	C 109	RDT	1	/71	
	HORLOGE A QUARTZ 1 MHZ(CLOCK,7 O/P-1HZ TO 1MHZ-200 TO 800 NSEC WIDTH,TTL LEVEL)	J HQ 10	SAIP	1	/71	
	REAL TIME CLOCK (3.8 USEC TO 18.2 HRS, PRESET-TIME AND PRESET-COUNT MODES)	RTC 2014	SEN	1	/71	
	CLOCK/TIMER	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	
.2	TIME BASE (10 TO 100MHZ IN INCREMENTS OF 10MHZ, USED WITH TD 2031/TD 2041)	TB 2032	SEN	1	/71	
	TIMER	C 76451-A12-A1	SIEMENS	0		(6)

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.3	TEST PULSE GENERATOR (5 TO 50 NSEC NIM O/P PULSE DERIVED FROM S1.F(25) OR EXT)	TPG 0202	GEC-ELLIOTT	1	/71	
		DUAL PROGRAMMED PULSE GENERATOR(50HZ/ 2KHZ/5MHZ PULSE TRAIN,LENGTH BY COMMAND)	2PPG 2016	SEN	1	/71	
		MULTIPULSER (0.5-300 MHZ BURSTS,NIM SIGNAL,TTL TRIGGER,NIM OUT,600PSEC RISE)	C 72454-A1450-A1	SIEMENS	2	/72	
	.7	SEQUENTIAL OUTPUT REGISTER (SERIAL-CODED NIM PULSES OUT,LOGIC 0=40NSEC,1=150NSEC)	SOR	SAIP	1	/71	

.132 PARALLEL OUTPUT REGISTERS (TTL,HTL,NIM ETC)

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	.11	12 BIT PARALLEL OUTPUT REGISTER (NIM)	3251	BI RA SYSTEMS	1	04/73	
		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	
	.12	DIFFERENTIAL OUTPUT REGISTER	3030	KINETIC SYSTEMS	1	/72	
		OUTPUT REGISTER (16BIT)	360	POLON	1	09/73	
		SINGLE 16 BIT PARALLEL OUTPUT REGISTER (WITH LED DISPLAY OPTION)	PR-609	TECHCAL	1	/71	
	.14	OUTPUT REGISTER (24BIT TTL VIA SPEC CONN 8BIT ALSO VIA FRONT PANEL LEMO)	FHC 1309	BF VERTRIEB	1	/72	
		24-BIT OUTPUT REGISTER	3071	KINETIC SYSTEMS	1	/72	
		PARALLEL OUTPUT REGISTER (24BIT TTL OUTPUT VIA 25-WAY CONNECTOR)	7054-3	NUCL. ENTERPRISES	1	/70	
		OUTPUT REGISTER (24BIT)	351	POLON	1	09/73	
		SINGLE 24 BIT PARALLEL OUTPUT REGISTER (WITH LED DISPLAY OPTION)	PR-611	TECHCAL	1	/71	
	.22	OUTPUT REGISTER (2X16BIT)	352	POLON	1	09/73	
		DUAL 16 BIT PARALLEL OUTPUT REGISTER (WITH LED DISPLAY OPTION)	PR-610	TECHCAL	1	/71	
	.23	OUTPUT REGISTER (2X16BIT VIA ISOLATING CONTACTS)	1082	BORER	1	/72	(4)
N	.24	DUAL 24 BIT PARALLEL OUTPUT REGISTER	3222	BI RA SYSTEMS	1	04/73	
		OUTPUT REGISTER (2X24BIT DATA OUT,DATA-READY + BUSY FORM HANDSHAKE, TTL)	RO-224	EG+G	1	/72	
		OUTPUT REGISTER (2X24BIT OR 6X8BIT, LED DISPLAY)	OR	JOERGER	1	/72	(7)
C		24-BIT DUAL OUTPUT REGISTER	9042	NUCL. ENTERPRISES	1	/72	(7)
N		DUAL OUTPUT REGISTER (2X24BIT, DATAWAY READ AND WRITE, HANDSHAKE CONTROL, LO-Z)	9043A	NUCL. ENTERPRISES	0		(7)
N		DUAL OUTPUT REGISTER (2X24BIT, DATAWAY READ AND WRITE, HANDSHAKE CONTROL, HI-Z)	9043B		0		(7)
		OUTPUT REGISTER (2X24BIT)	353	POLON	2	09/73	
		PARALLEL OUTPUT REGISTER (2X24 BITS)	J RS 10	SAIP	1	04/73	(7)
		DUAL 24 BIT PARALLEL OUTPUT REGISTER (WITH LED DISPLAY OPTION)	PR-612	TECHCAL	1	/71	(6)
		OUTPUT REGISTER/DRIVER (2X24BIT,OPTION ON POLARITY AND OPEN COLLECTOR OUTPUTS)	171	WALLAC	1		
	.41	DIGITALES AUSGANGSREGISTER(4X8BIT PARALL OUTPUT REGISTER,NO L,TTL,1=H)	DO 200-2501	DORNIER	1	/71	
		(WITH FRONT PANEL CONNECTOR)	DO 200-2701		1	/72	
	.72	OUTPUT REGISTER (32X16BIT, EX. ADDRESS)	101	HYTEC	1		
		128 BIT OUTPUT REGISTER (ADDRESSABLE AS 8 16BIT OR 128 1-BIT WORDS)	C 342	INFORMATEK	1	04/73	
	.74	OUTPUT REGISTER (256X24BIT, EX. ADDRESS)	110	HYTEC	1		
		OUTPUT REGISTER (256X24BIT, EX. ADDRESS)	109		1		
		OUTPUT REGISTER (32X24BIT, EX. ADDRESS)	104		1		
		OUTPUT REGISTER (32X24BIT, EX. ADDRESS)	100		1		
		OUTPUT REGISTER (16X24BIT, EX. ADDRESS)	105		1		

.133 PARALLEL OUTPUT DRIVERS (OPEN COLL.,RELAY, ETC)

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.11	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)

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	.11	8 BIT TRIAC OUTPUT REGISTER	3080	KINETIC SYSTEMS	1	05/73	
		SWITCH (12BIT DATAWAY CONTROLLED RELAY REGISTER FOR SWITCHING AND MULTIPLEXING)	7066-1	NUCL. ENTERPRISES	1	/71	
	.12	DRIVER (16BIT,OPEN COLLECTOR OUTPUT VIA MULTIWAY CONNECTOR,MAX 150MA/LINE)	9002	NUCL. ENTERPRISES	1	/71	
		DIGITAL OUTPUT 16 BIT POT 24V	C 76451-A9-A1	SIEMENS	0		(6)
		SINGLE 16 BIT PARALLEL OUTPUT REGISTER/DRIVER(WITH LED DISPLAY OPTION)	PR-609-A	TECHCAL	1	/71	
	.13	DIGITAL OUTPUT 16 BIT RELAYS	C 76451-A9-A2	SIEMENS	0		(6)
	.14	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)
		SINGLE 24 BIT PARALLEL OUTPUT REGISTER/DRIVER(WITH LED DISPLAY OPTION)	PR-611-A	TECHCAL	41	/71	
	.22	OUTPUT DRIVER (2X16BIT, 40MA SINKING, WITH READ VIA DATAWAY, 1=LO)	OD 1613	GEC-ELLIOTT	1	/72	
		(SAME, 1=HI)	OD 1614		1	/72	
		OUTPUT DRIVER (2X16BIT, 125MA SINKING, WITH READ VIA DATAWAY, 1=LO)	OD 1617	GEC-ELLIOTT	1	/72	
		(SAME, 1=HI)	OD 1618		1	/72	
		OUTPUT DRIVER (2X16BIT, TOTEMPOLE FOR 30 TTL LOADS, WITH READ VIA DATAWAY)	OD 1620	GEC-ELLIOTT	1	/72	
		DUAL 16 BIT OUTPUT REGISTER (TTL LEVELS, OPEN COLL OUTPUTS VIA CABLE)	20R 2008	SEN	1	/70	
		DUAL 16 BIT PARALLEL OUTPUT REGISTER/DRIVER(WITH LED DISPLAY OPTION)	PR-610-A	TECHCAL	1	/71	
	.24	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, WITH READ VIA DATAWAY, 1=LO)	OD 2403	GEC-ELLIOTT	1	/72	
		(SAME, 1=HI)	OD 2404		1	/72	
		OUTPUT DRIVER (2X24BIT, 125MA SINKING WITH READ VIA DATAWAY, 1=LO)	OD 2407	GEC-ELLIOTT	1	/72	
		(SAME, 1=HI)	OD 2408		1	/72	
		OUTPUT DRIVER (2X24BIT, TOTEMPOLE FOR 30 TTL LOADS, WITH READ VIA DATAWAY)	OD 2410	GEC-ELLIOTT	1	/72	
		DUAL 24 BIT OUTPUT REGISTER(DC OR PULSE O/P,UPDATING O/P STROBE,TTL OPEN COLL)	40	JORWAY	1	/71	(2)
C		DUAL 24-BIT OUTPUT REGISTER (OPEN COLL DRIVERS, MAX 24V OR 250MA, REAR OUTPUTS)	3072	KINETIC SYSTEMS	1		
		DUAL 24 BIT PARALLEL OUTPUT REGISTER/DRIVER(WITH LED DISPLAY OPTION)	PR-612-A	TECHCAL	41	/71	
	.41	DIGITALES AUSGANGSREGISTER(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	
		DIGITALES AUSGANGSREGISTER(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	
		DIGITALES AUSGANGSREGISTER MIT REED-RELAIS(4X8BIT OUTPUT REG,OPEN CONTACT=0)	DO 200-2504	DORNIER	1	/71	
		(WITH FRONT PANEL CONNECTOR)	DO 200-2704		1	/71	

.137 OTHER DIGITAL OUTPUT MODULES (SIMPLE)

.137 NO PRODUCTS IN THIS CLASS

.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

.141 SERIAL I/O REGISTERS (GENERAL PURPOSE)

.141 NO PRODUCTS IN THIS CLASS

.142 PARALLEL I/O REGISTERS (GENERAL PURPOSE)

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.142	UNIVERSAL INPUT/OUTPUT REGISTER (36BIT DATA+RANGE IN,12BIT REG O/P FOR CONTROL)	1031	BORER	1	/72	(3)

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.22	DUAL INPUT DUAL OUTPUT REGISTER (16BIT, TTL IN, OPEN COLL TTL OUT, MAX 40MA,30V)	C110	RDT	1	/72	
	.24	INPUT/OUTPUT REGISTER (2X24BIT IN,2X6BIT OUT, HI-Z INPUT, LED DISPLAY)	IR	JOERGER	1	/72	(7)
	.143	PERIPHERAL INTERFACING MODULES (FOR TTY, TAPE ETC)					
	.11	DESK CALCULATOR CTRL (DIEHL INTERFACE TO FHC 1301/02/11 AND FHC 1309)	FHC 1312	BF VERTRIEB	1	/72	
		TYPEWRITER DRIVE UNIT	TD 0801	GEC-ELLIOTT	2	06/73	(1)
		TYPEWRITER DRIVER FOR OPTIMA 527	501	POLON	0	09/73	
	.12	TELETYPE O/P CTRL (10 FHC 1301/02/11 AND FHC 1309 VIA SPEC CONN,TTY MOTOR ON/OFF)	FHC 1307	BF VERTRIEB	1	/71	(1)
C		TELETYPE INTERFACE	90	JORWAY	2	/71	
		TELETYPEWRITER DRIVER (FOR ASR 33)	7043-1	NUCL. ENTERPRISES	1	/70	
		TELETYPEWRITER INTERFACE(I/O DATA TRANSF AND CONTROL,LAM USED AS TWO-WAY FLAG)	7061-1	NUCL. ENTERPRISES	1	/70	(1)
		TELETYPEWRITER DRIVER	500	POLON	1	09/73	
		TELETYPE DRIVER	J TY 10	SAIP	1	06/73	
		TELETYPE INTERFACE	C-T-33	WENZEL ELEKTRONIK	1	/72	
N	.13	VERSATEC LINE PRINTER INTERFACE	3320	KINETIC SYSTEMS	1	/72	
	.21	PAPER TAPE PUNCH OUTPUT DRIVER (FOR FACIT 4070)	TP 0801	GEC-ELLIOTT	1	06/73	(1)
	.22	TAPE READER INTERFACE UNIT (FOR ELECTROGRAPHIC READER)	TR 0801	GEC-ELLIOTT	1	06/73	(1)
	.7	UNIVERSAL ASYNCHRONOUS TRANSMITTER/RECEIVER (129 CHAR.BUFFER)	C 317	INFORMATEK	1	03/73	
		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)	7058-1	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					
	.1	24 BIT LED BCD DISPLAY (ONE FHC 1301/02/11 VIA SPEC CONNECTOR)	FHC 1305	BF VERTRIEB	1	/71	(1)
		24 BIT NIXIE BCD DISPLAY (SELECTS ONE OF 10 FHC 1301/02/11 VIA SPEC CONNECTION)	FHC 1306	BF VERTRIEB	2	/71	(1)
		24 BIT LED BINARY DISPLAY (ONE FHC 1313 OR FHC 1309 VIA SPECIAL CONNECTION)	FHC 1315	BF VERTRIEB	1	/72	
		INDICATOR (1X16BIT OR 2X8BIT,INDICATES STATE OF REGISTER LOADED FROM DATAWAY)	9014	NUCL. ENTERPRISES	1	/71	
		AFFICHAGE DECIMAL PAR L INTERMEDIAIRE D UN CALCULATEUR (DISPLAY OF 24BIT WORD)	J AF 15	SAIP	2	/71	
		AFFICHAGE BINAIRE MANUEL (CONTENT OF A REGISTER DISPLAYED,EXT MULTIWAY CONN)	J AF 20	SAIP	1	/71	
	.2	DISPLAY DRIVER (POINTPLOT CHAR GEN AND VECTOR GENERATOR)	DD 1601	GEC-ELLIOTT	2	06/73	(7)
		MEMORY OSCILLOSCOPE DISPLAY (VECTOR, CHARACTER AND HISTOGRAM GEN)	C 311	INFORMATEK	2	05/73	
		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	
		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)
		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	

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.2	STORAGE OSCILLOSCOPE (DRIVER FOR TEKTRONIX 611 OR 601,USED WITH 7011)	9028	NUCL. ENTERPRISES	0	/71	(2)
		SCOPE DISPLAY DRIVER	J DD 10	SAIP	2	04/73	(7)
		MANUAL CONTROL OF J DD 10	MC 10		NA		
		EXTERNAL DISPLAY FOR J EA 10 SCALER	C AE 10	SAIP	NA	04/73	
		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	
	.7	THE WDV 3300 INTERACTIVE GRAPHICS SYSTEM COMPRISING		WDV			
		DISPLAY UNIT	WDV 1855		0		
		LIGHT PEN	WDV 1851		0		
		GRAPHIC DATASENSOR	WDV 1833 G		0		

.145 INSTRUMENTATION INTERFACING MODULES (DVM, SUPPLY CTR, STEPPING MOTOR DRIVERS, PULSE ANALYSER CTR)

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	.1	DUAL 15 CHANNEL SERIAL OUTPUT MODULE	3111	BI RA SYSTEMS	2	04/73	
		STEP MOTOR DRIVER (MAX 32768 STEPS,RATE, ROTATION AND START/STOP FULLY COMMANDED)	1161	BORER	1	/72	(3)
		STEPPING MOTOR CONTROLLER, DUAL	3360	KINETIC SYSTEMS	1	/72	(4)
		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	
		COMMANDE DE MOTEUR PAS A PAS (STEPPING MOTOR DRIVER)	J CP 10	SAIP	1	01/73	
		STEPPER CONTROLLER	C-ST-C-5	WENZEL ELEKTRONIK	2	/72	
		STEPPER CONTROLLER - INCREMENTAL MOTOR	C-ST-C-5I	WENZEL ELEKTRONIK	2	/72	
N		STEPPER CONTROLLER (START,STOP,DIRECTION AND SPEED CONTROL OF STEPPING MOTOR)	C-STC-4/C-STC-4-I	WENZEL ELEKTRONIK	2		(7)
	.2	POWER SUPPLY CONTROLLER 10-BIT	3155	KINETIC SYSTEMS	1	/71	(4)
		POWER SUPPLY CONTROLLER 12-BIT	3156	KINETIC SYSTEMS	1	/72	
	.3	MCA INTERFACE (I/O MODULE FOR MULTI-CHANNEL ANALYSER)		PACKARD	3		(4)
		INTERFACE CAMAC POUR CODEUR CA25/CA13/ C97 (INTERFACING PULSE ADC TO CAMAC)	J CCA 10	SAIP	2	/71	
	.4	DUAL INCREMENTAL POSITION ENCODER (2X20 BIT X-Y DIGITIZATION BY UP-DOWN COUNTER)	2IPE 2019	SEN	1	/71	
	.7	OUTPUT REGISTER (16 OR 24 BIT TTL DRIVER FOR FAST-ROUTING MULTIPLEXER SYSTEM)	CM 665	J AND P	1	/71	
		CAMAC COMMUNICATIONS CONTROLLER INTERFACE UNIT	MC 4036	MICRO CONSULTANTS	1	/71	(2)
		CAMAC VID-MOS INTERFACE UNIT	MC 4037	MICRO CONSULTANTS	1	/71	(2)
		CAMAC MOD 15 INTERFACE UNIT (TO IN-HOUSE PRODUCED A-D EQUIPMENT)	MC 5201	MICRO CONSULTANTS	1	/71	(2)
		INTERFACE FOR CAMAC CONTROL OF PRECISION HIGH SPEED ADCS	MC 4059	MICRO CONSULTANTS	0		(6)
		WIRE DETECTOR SCANNER(64X16BIT MEMORY STORES 13BIT POSITION+3BIT CLUSTER DATA)	WCS-200	NANO SYSTEMS	1	/72	(5)
		SCANNER TEST MODULE	WCS-201		1	/72	(5)
		PROPORTIONAL CHAMBER READ-OUT (USED WITH SPEC CONTROLLER TYPE COFIL OR ALONE)	REFIL	SAIP	2	/71	
		SPARK CHAMBER READ OUT (POSITION AND ADDRESS CODING OF MULTIPLE SPARK SITES)	J SC 10/SCRO-041	SAIP	2	/70	(6)
		SPARK CHAMBER READ OUT TERMINAL	SCRO TML-043		5	/70	
		PLUMBICON READ OUT (5 SCALERS RECORD DIGITIZED OUTPUTS FROM PLUMBICON CAMERA)	J PM 10/PLUM	SAIP	1	/71	(6)
		PLUMBICON READ OUT TERMINAL	J PG 10/PUDDING		1	/71	(6)
		DIGITAL CONTROL MODULE(BIDIRECTIONAL CON TROL VIA R/W-LINES OF FOUR 4BIT DEVICES)	TC-0440	TECHCAL	2	/71	
		DIGITAL CONTROL MODULE(BIDIRECTIONAL CON TROL VIA R/W-LINES OF FOUR 8BIT DEVICES)	TC-0840	TECHCAL	2	/71	

.147 OTHER DIGITAL I/O MODULES (INCL. DATA LINKS)

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.147	START-STOP CONTROLLER(START,STOP,RESET, MANUAL OR DATAWAY CONTROL, 100HZ CLOCK)	FHC 1304	BF VERTRIEB	1	/71	(1)

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	.147	DATA LINK MODULE (16 BIT)	6701	BI RA SYSTEMS	2	05/73	
		SENSOR (INTER. UP TO 65.000 GROUPS OF 16/32 BITS, READS PATTERNS OR ADDRESSES)	C 347	INFORMATEK	1	04/73	
		TRANSMISSION LINE DRIVER		POLON	0		
N		DATA RECEIVER FOR MECHANICAL OPERATIONS (5 DECADE DATA,3 DECADE INSTRUCTION REG)	C 501	RDT	0		(7)
		COMMANDE *ARRET-MARCHE* (START-STOP UNIT ,START,STOP,CLOCK, AND GATE OUTPUTS)	J AM 10	SAIP	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					
	.151	FAN-OUT UNIT (2 ORED INPUTS PROVIDE 8 TRUE,2 COMPLEM OUTPUTS,NIM SIGNALS)	FO 0801	GEC-ELLIOTT	1	/71	
		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					
N	.152	6 CHANNEL TTL/NIM CONVERTER	5601	BI RA SYSTEMS	1	04/73	
N		6 CHANNEL NIM/TTL CONVERTER	5602	BI RA SYSTEMS	1	04/73	
N		HEX NIM TO TTL CONVERTER	3473	KINETIC SYSTEMS	1	05/73	
		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					
N	.153	CAMAC BCD-TO-BINARY CONVERTER	LEM-52/5.7	EISENMANN	1		
		BINARY TO-BCD-CONVERTER (24BIT BIN,8 DECIMAL DIGIT OUTPUT VIA TWO CONNECTORS)	7068-1	NUCL. ENTERPRISES	1	/70	(2)
N		BINARY CODE CONVERTER(BIN-BCD OR BCD-BIN CONVERSION, DATA FROM DATAWAY OR FRONT)	9044	NUCL. ENTERPRISES	0		(7)
		BINARY TO DECIMAL CODE CONVERTER	610	POLON	1	10/73	
		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					
	.154	CAMAC 16 WORD 24 BIT MEMORY	MC 5202	MICRO CONSULTANTS	2	/72	(6)
		16 WORD STORE	CS 0003	NUCL. ENTERPRISES	1		(4)
		256 WORDS OF 24 BIT STORE MODULE	CS 0015	NUCL. ENTERPRISES	1	/72	(7)
		PROGRAMMABLE READ ONLY MEMORY	220	POLON	1		
		MEMOIRE TAMPON (BUFFER MEMORY,256 13BIT WORDS, USABLE WITH J CAN 21 C/H)	J MT 20	SAIP	1	/72	
		.155 LOGIC AND ARITHMETIC PROCESSING MODULES					
	.155	FLOATING POINT ARITHMETIC INTERFACE (FOR USE WITH M 128 HARD. FLOAT. POINT)	C 327	INFORMATEK	1	01/73	
		.157 OTHER DIGITAL HANDLING AND PROCESSING MODULES (INCL. DELAY UNITS)					
	.157	NO PRODUCTS IN THIS CLASS					
		.16 ANALOGUE MODULES --ADC,DAC,MULTIPLEXERS,AMPLIFIERS,LINEAR GATES,DISCRIMINATORS ETC					
		.161 ANALOGUE INPUT MODULES (DC AND PULSE ADC, TDC)					
	.1	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)

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.1	ANALOGUE TO DIGITAL INTEGR. CONVERTER	700	POLON	1	09/73	
		CONVERTISSEUR TENSION-FREQUENCE (ADC USED WITH MULTIPLEXERS J MX 10/20)	J CTF 10	SAIP	2	04/73	
		UP-DOWN SCALER/FREQUENCY METER	J EF 10		1	04/73	
		DUAL DIGITAL VOLTMETER (+AND- 0.1V, 10 BIT, DIFFERENTIAL INPUT)	2DVM 2013	SEN	1	/71	
		DIGITALVOLTMETER (RANGES: DC0.02 TO 20V, 5 MA TO 100 MA,AC 0.0I TO 20 V BOTH POL)	C 76451-A13-A1	SIEMENS	2		
		DIGITAL VOLTMETER (SAME AS TYPE C 76451-A13-A1 WITH DISPLAY)	C 76451-A13-A2	SIEMENS	2		
	.11	ANALOGE EINGAENGE(MULTIPLEXER-ADC,8 I/P TO ONE ADC,+/-10V RANGE,7BITS/10V+SIGN)	DO 200-1011	DORNIER	2	/72	
		(SAME WITH 8 DIFFERENTIAL INPUTS)	DO 200-1013		2	/72	
		ANALOGE EINGAENGE(MULTIPLEXER-ADC,8 I/P TO ONE ADC,+/-5V RANGE,7BITS/ 5V+SIGN)	DO 200-1014	DORNIER	2	/72	
		(SAME WITH 8 DIFFERENTIAL INPUTS)	DO 200-1016		2	/72	
		ANALOGE EINGAENGE(MULTIPLEXER-ADC,8 I/P TO ONE ADC, +10V RANGE,8BITS/10V)	DO 200-1017	DORNIER	2	/72	
		(SAME WITH 8 DIFFERENTIAL INPUTS)	DO 200-1019		2	/72	
		ANALOGER EINGANG (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	
		SINGLE 8 BIT A/D CONVERTER	S-AD-008	TECHCAL	1	/72	(6)
		DUAL 8 BIT A/D CONVERTER	D-AD-008	TECHCAL	1	/72	(6)
N	.12	DUAL 10 BIT ANALOG TO DIGITAL CONVERTER	3515	KINETIC SYSTEMS	1	03/73	
		SINGLE 10 BIT A/D CONVERTER	S-AD-010	TECHCAL	1	/72	(6)
		DUAL 10 BIT A/D CONVERTER	D-AD-010	TECHCAL	1	/72	(6)
	.13	DUAL SLOPE ADC (+AND- 0.01/1/10V RANGES, 11BIT RESOLUTION,20MS CONV TIME)	1241	BORER	2	/72	(3)
		SUCCESS. APPROX. ADC (11BIT+SIGN, +AND-10V DIFF IN, 20 USEC CONVERSION)	1242	BORER	2	/72	(4)
		SUCCESS. APPROX. ADC (AS 1242 BUT WITH SAMPLE AND HOLD)	1243	BORER	2	/72	
		ANALOGE EINGAENGE (MULTIPLEXER-ADC,8 I/P TO ONE ADC,+/-10V RANGE,11BITS/10V+SIGN)	DO 200-1001	DORNIER	2	/72	
		(SAME WITH 8 DIFFERENTIAL INPUTS)	DO 200-1003		2	/72	
		ANALOGE EINGAENGE(MULTIPLEXER-ADC,8 I/P TO ONE ADC,+/-5V RANGE,11BITS/ 5V+SIGN)	DO 200-1004	DORNIER	2	/72	
		(SAME WITH 8 DIFFERENTIAL INPUTS)	DO 200-1006		2	/72	
		ANALOGE EINGAENGE(MULTIPLEXER-ADC,8 I/P TO ONE ADC, +10V RANGE, 12BITS/10V)	DO 200-1007	DORNIER	2	/72	
		(SAME WITH 8 DIFFERENTIAL INPUTS)	DO 200-1009		2	/72	
		ANALOGER EINGANG (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	
		A/D CONVERTER (12BIT,MAX 20 USEC CONVERSION, +AND-5V, +AND-10V, +10V RANGES)	30	JORWAY	2	/71	(2)
N		DUAL 12 BIT ANALOG TO DIGITAL CONVERTER	3520	KINETIC SYSTEMS	1	05/73	
		CAMAC ADC/DAC UNIT (PC CARD FOR SAMPLE-HOLD 12BIT ADC AND DAC CIRCUITS)	MC 5200	MICRO CONSULTANTS	1	/72	(6)
		ANALOGUE TO DIGITAL CONVERTER (12BIT, 20 MSEC CONVERSION,RANGE -5V TO +5V)	7055-1	NUCL. ENTERPRISES	1	/70	
		SINGLE 12 BIT A/D CONVERTER	S-AD-012	TECHCAL	1	/72	(6)
		DUAL 12 BIT A/D CONVERTER	D-AD-012	TECHCAL	1	/72	(6)
	.14	ANALOGER EINGANG(DUAL SLOPE ADC, +/-10V RANGE,14BITS/10V+SIGN,0.2SEC CONVERSION)	DO 200-1021	DORNIER	1	/72	
N	.2	OCTAL CHARGE DIGITIZER (8X8BIT CHARGE SENSITIVE ADC, READOUT IN 4X16BIT WORDS)	QD808	EG+G	0		(7)
N		OCTAL FAST ANALOG TO DIGITAL CONVERTER	3540	KINETIC SYSTEMS	1	06/73	
		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, 150USEC CONVERSION,COMMON GATE,NIM LEVELS)	2248	LRS-LECROY	1	/71	

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.2	OCTAL ADC (MIN 5 NSEC PULSES, POS OR NEG 8BIT/100 PC RESOLUTION, 250 USEC CONV)	9040	NUCL. ENTERPRISES	1	/72	(4)
		CONVERTISSEUR ANALOGIQUE NUMERIQUE A 512 CANAUX(PULSE ADC,10MHZ CLOCK,0.1/10V)	J CAN 31	SAIP	3	/71	
		CONVERTISSEUR ANALOGIQUE NUMERIQUE RAPIDE A 8000 CANAUX(PULSE ADC,100MHZ CLOCK)	JCAN20C/JCAN20H	SAIP	6	/71	
		INTERFACE POUR CODEUR J CAN 20 ET BLOC MEMOIRE BM 96 (ADC-MEMORY INTERFACE)	J CAN 20 I		2	/71	
		CONVERTISSEUR ANALOGIQUE NUMERIQUE (16.000 CHANNEL PULSE ADC, 200MHZ CLOCK)	J CAN 21 C/H	SAIP	6	/72	(6)
		CONVERTISSEUR ANALOGIQUE DIGITAL (1024 CHANNEL PULSE ADC, 100MHZ CLOCK)	J CAN 40	SAIP	2	/72	(6)
	.3	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	1		(7)
		QUAD 16-BIT SPARK READ-OUT REGISTER (20MHZ RATE,TTL LEVELS)	SR 1604	GEC-ELLIOTT	1	/71	
		QUAD TIME-TO-DIGITAL CONVERTER(9BIT/CH, 102/510NSEC RANGES,13USEC CONVERS,NIM)	2226A	LRS-LECROY	1	/70	(2)
		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	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.162	ANALOGER AUSGANG (DAC, 12BIT RESOLUTION, +10V OUTPUT RANGE, 20MA)	DO 200-1501	DORNIER	2	/71	
		(SAME BUT WITH +AND-10V OUTPUT RANGE)	DO 200-1503		2	/71	
		(SAME BUT WITH +AND-5V OUTPUT RANGE)	DO 200-1505		2	/71	
		ANALOGE AUSGAENGE (DAC,12BIT RESOLUTION, +10V OUTPUT RANGE,2 OUTPUTS, 20MA)	DO 200-1502	DORNIER	2	/71	
		(SAME BUT WITH +AND-10V OUTPUT RANGE)	DO 200-1504		2	/71	
		(SAME BUT WITH +AND-5V OUTPUT RANGE)	DO 200-1506		2	/71	
		OCTAL DAC (8 CHANNELS,10BIT 5V 50OHMS OR 2 S CMPL 9BIT+SIGN, +AND- 5V, 10 USEC)	DAC 1081	GEC-ELLIOTT	1	04/73	(7)
		D/A CONVERTER (12BIT,5 USEC CONVERSION, O/P RANGES +AND-2.5V/5V/10V AND +5V/10V)	31	JORWAY	1	/71	(2)
N		8 CHANNEL 10 BIT D-A CONVERTER	3110	KINETIC SYSTEMS	1	/72	
		CAMAC ADC/DAC UNIT (PC CARD FOR SAMPLE-HOLD 12BIT ADC AND DAC CIRCUITS)	MC 5200	MICRO CONSULTANTS	1	/72	(6)
		DIGITAL TO ANALOGUE CONVERTER	7015	NUCL. ENTERPRISES	1	/70	
		DIGITAL TO ANALOGUE CONVERTER	720	POLON	1	09/73	
		DIGITAL TO ANALOGUE CONVERTER	721	POLON	2	09/73	
		TENSION D ETALONAGE (VOLTAGE CALIBRATOR)	J ET 10	SAIP	1	04/73	
		DUAL DIGITAL-TO-ANALOG CONVERTER (10BIT, OUTPUT 0 TO +10V OR -5 TO +5V)	2DAC 2011	SEN	1	/71	
		STROMGENERATOR (CURRENT SOURCE)	C 76451-A5-A1	SIEMENS	2		
C		DUAL-DIGITAL-ANALOG-CONVERTER	C 76451-A15-A1	SIEMENS	1		
		(SAME WITH 12 BIT)	C 76451-A15-A2		1		(6)
		(SAME WITH 16 BIT)	C 76451-A15-A3		1		(6)
		DUAL DIGITAL TO ANALOG CONVERTER (10BIT RESOLUTION,10MSEC CONV TIME,O/P 5V MAX)	DA-2000	TECHCAL	1	/71	
		SLAVE BOARD DUAL D/A CONVERTER	DA-2001		1	/71	

.163 ANALOGUE I/O MODULES (ADC/DAC, ETC)

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.163	NO PRODUCTS IN THIS CLASS					

.164 ANALOGUE HANDLING AND PROCESSING MODULES I (MX)

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.11	ELEKTRONISCHER MULTIPLEXER (8 DIFF I/P, MAX +OR-10V, DATAWAY SET+INCR ADDRESS)	DO 200-1033	DORNIER	1	/72	
		(WITH FRONT PANEL CONNECTOR)	DO 200-1233		1	/72	
		12 INPUT ANALOGUE MULTIPLEXER (RANDOM OR SCAN ACCESS CONTROLLED BY SKIP REGISTER)	MX 2025	SEN	1	/72	(6)

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.12	15 CHANNEL MULTIPLEXER (ANALOGUE SIGNALS ROUTED TO ADC/DVM,DIRECT + SCAN MODES)	1701	BORER	1	/72	(3)
		SEE ALSO DORNIER ADC TYPES		DORNIER			
		RELAISMULTIPLEXER (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	
		RELAIMULTIPLEXER (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)
N		15 CHANNEL RELAY MULTIPLEX	3530	KINETIC SYSTEMS	2	01/73	
		MULTIPLEXEUR A RELAIS (16 CHANNELS, STANDARD LEVEL)	J MX 10	SAIP	1	04/73	
		(SAME FOR LOW LEVEL)	J MX 20		1	04/73	
		MULTIPLEXER MANUAL CONTROL	J AX 10		1	04/73	
	.13	16-CHANNEL FAST MULTIPLEXER (FET SWITCHES FOR ADC 1242 AND 1243)	1704	BORER	1	/72	(4)
		ELEKTRONISCHER MULTIPLEXER (16 CHANNELS, MAX +OR-10V,DATAWAY SET+INCR ADDRESS)	DO 200-1031	DORNIER	1	/72	
		(WITH FRONT PANEL CONNECTOR)	DO 200-1231		1	/72	
		ELEKTRONISCHER 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	
		FET ANALOG MULTIPLEXER (15 CHANNELS, MANUAL AND DATAWAY SELECT, EXPANDABLE)	AM/FET	JOERGER	1	02/73	
		MULTIPLEXER-SOLID STATE (16 SINGLE-ENDED OR 8 DIFF CHAN,RANDOM OR SEQUENT ACCESS)	9026	NUCL. ENTERPRISES	1	/71	
	.14	MULTIPLEXER (32 CHANNEL, 2 CONTACTS)	C 76451-A4-A1	SIEMENS	2		
		MULTIPLEXER (32 CHANNEL, 4 CONTACTS)	C 76451-A4-A2	SIEMENS	2		
	.15	32-CHANNEL FAST MULTIPLEXER (FET SWITCHES FOR ADC 1242 AND 1243)	1703	BORER	1	/72	(4)
		ELEKTRONISCHER MULTIPLEXER (32 CHANNELS, MAX +OR-10V, DATAWAY SET+INCR ADDRESS)	DO 0200-1032	DORNIER	1	/72	
		(WITH FRONT PANEL CONNECTOR)	DO 200-1232		1	/72	
		ELEKTRONISCHER 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	

.165 ANALOGUE HANDLING AND PROCESSING MODULES II (LIN. GATES, AMPL., DISCRIMINATORS ETC)

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.2	SAMPLE-AND-HOLD VERSTAERKER(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	
		PROGRAMMIERBARER VERSTAERKER/ABSCHW (ATTENUATION -60DB TO 0DB, 6 STEPS, AMPLIFICATION 0DB TO 60DB, 6 STEPS)	DO 200-1052	DORNIER	2	04/73	
		DIFFERENTIAL AMPLIFIER (GAIN CONTROLLED FROM DATAWAY)	CS 0014	NUCL. ENTERPRISES	2	/72	
	.3	DUAL ATTENUATOR(50 OHMS,DATAWAY CONTROL-LED,RANGE 0DB TO 31DB IN 1DB STEPS)	9004	NUCL. ENTERPRISES	1	/71	
		ATTENUATEUR PROGRAMMABLE(MAN AND DATAWAY CONTROL OF ATTENUATION,0 DB TO 60 DB)	J AT 10	SAIP	3	/70	
	.4	DIGITAL WINDOW DISCRIMINATOR (WITH 128X16BIT BUFFER, PARALLEL + SERIAL I/P)	DWD 2046	SEN	1	/72	

.167 OTHER ANALOGUE MODULES

.167 NO PRODUCTS IN THIS CLASS

.17 OTHER DIGITAL AND/OR ANALOGUE MODULES --MIXED ANALOGUE AND DIGITAL,NOT DATAWAY CONNECTED ETC

.17 NO PRODUCTS IN THIS CLASS

2 SYSTEM CONTROL (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	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.211	EXECUTIVE SUITE		GEC-ELLIOTT			
		ASSEMBLY OF MODULAR CONTROLLERS IN CAMAC					
		CRATE, COVERS SYSTEM COMPLEXITY FROM					
		SINGLE SOURCE-SINGLE CRATE TO MULTI					
		SOURCE-MULTI CRATE SYSTEMS,COMPRISING					
		EXECUTIVE CONTROLLER (TRANSFORMS	MX-CTR-2		2	/72	
		STANDARD CRATE INTO SYSTEM CRATE)					
		BRANCH COUPLER (ONE PER BRANCH, MAX 7)	BR-CPR-2		2	/72	
		AND SYSTEM INTERFACE SOURCE UNITS, ALSO		GEC-ELLIOTT			
		OPTIONALLY AUTONOMOUS CONTROLLER SOURCE					
		UNITS (ALL INSERTED INTO SYSTEM CRATE)					
		AUTONOMOUS CONTROLLER 1 (FOR MULTILEVEL	SC-ACU-1	GEC-ELLIOTT	1	06/73	
		AUTONOMOUS BLOCK TRANSFERS VIA DMA)					
		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	SI-BUS-X11			/72	
		ALL SI SOURCE UNITS FORMING INTERFACE)					
		INTERRUPT VECTOR GENERATOR (ADDS AUTONO-	IVG-11		1	/72	
		MOUS ENTRY OF GL-DERIVED INTERRUPTS)					
		DIRECT MEMORY ACCESS INTERFACE (ADDS	DMA-11		1	06/73	
		MULTICHANNEL DMA,NEEDS AUTONOMOUS CTRL)					
		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	04/73	
		INTERDATA 70-SERIES SYSTEM INTERFACE		GEC-ELLIOTT			
		COMPRISING					
		PROGRAM TRANSFER INTERFACE	PTI-70 C/D		3	04/73	
		I/O BUS TERMINATION UNIT	TRM-70		1		
		SYSTEM INTERFACE BUS	SI-BUS-X70			04/73	
		INTERRUPT VECTOR GENERATOR	IVG-70		1	04/73	
		HONEYWELL 316/516 SYSTEM INTERFACE,COMPR		GEC-ELLIOTT			
		PROGRAM TRANSFER INTERFACE	PTI-H16 C/D		3	05/73	
		I/O BUS TERMINATION UNIT	TRM-H16		1		
		SYSTEM INTERFACE BUS	SI-BUS-XH16			05/73	
		GEC 2050/4080 SYSTEM INTERFACE, COMPR		GEC-ELLIOTT			
		DIRECT TRANSFERS INTERFACE	PTI-2050 C/D		3	05/73	
		SYSTEM INTERFACE BUS	SI-BUS-X2050			05/73	
		SYSTEM CRATE TEST UNIT (TWO-COMMAND TEST	SC-TST-1	GEC-ELLIOTT	3	/72	
		UNIT FOR CHECKING SYSTEM CRATE SYSTEMS)					
C	.1	MICROPROGRAMMED BRANCH DRIVER FOR PDP-11	1201	BI RA SYSTEMS	NA	/72	(5)
N		CAMAC BRANCH DRIVER FOR PDP-11	1252	BI RA SYSTEMS	2	05/73	
		INTERFACE/SYSTEM CONTROLLER TO DEC PDP9	2202	BORER	NA	/71	(4)
		(PROGR,SEQUENT AND BLOCK TRANSFERS)					
		INTERFACE/SYSTEM CONTROLLER TO DEC PDP15	2203	BORER	NA	/71	(4)
		(PROGR,SEQUENT AND BLOCK TRANSFERS)					
		PDP-11 CAMAC CONTROLLER(SEQUENTIAL READ/	CA 11-A	D E C	NA	/71	(2)
		WRITE,24 GRADED-L INTERRUPT DIRECTLY)					
		PDP-15 CAMAC INTERFACE(18/24BIT,PROGR,	CA 15 A	D E C	NA	/71	(1)
		SEQUENT ADDR AND BLOCK TRANSFER MODES)					
		PDP-9 CAMAC INTERFACE	CA 15 A/PDP-9	D E C	NA	/71	
		(SOMEWHAT MODIFIED CA 15 A)					
		PDP-11 INTERFACE/BRANCH DRIVER	CA 11-C	D E C	NA	/72	(4)
		(24 VECTOR ADDRESSES, PROGRAMMED AND					
		MULTIPLE DMA-TRANSFER, ADDRESS SCAN AND					
		-LIST MODE, REPEAT-, LAM- AND STOP MODE)					
		PDP-11 BRANCH DRIVER (EUR 4600 COMPATI-	BD-011	EG+G	NA	/71	
		BLE,PROGRAMMED AND SEQUENT ADDR MODES)					
		PDP-11 BRANCH DRIVER	KS 0011	KINETIC SYSTEMS	NA	/71	(4)
C		INTERFACE AND DRIVER FOR PDP 11 OR PDP 8		NUCL. ENTERPRISES			
		SYSTEM, COMPRISING					
C		16-BIT CONTROLLER (WITH EITHER OF THE	9030		3	/72	(7)
		FOLLOWING INTERFACE CARDS)					
		PDP 11 INTERFACE CARD	9032			/72	
C		INTERFACE CARD FOR DEC PDP 8 SERIES	9034			04/73	(7)
C		BRANCH INTERFACE	9031		2	/72	(7)

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
		INTERFACE CAMAC-PDP 11 (PROGRAMMED,BLOCK TRANSFER AND SEQUENTIAL ADDR MODES)	ICP 11/CP 11 A	SAIP	NA	/71	(4)
		PDP-11 SYSTEM CONTROLLER	C-CSC-11	WENZEL ELEKTRONIK	2	/72	
C	.2	NOVA BRANCH DRIVER	1251	BI RA SYSTEMS	NA	04/73	(5)
		NOVA COMPUTER TO CAMAC MASTER BRANCH HIGHWAY DRIVER (ONE TO THREE BRANCHES)	MC-2010	TECHCAL	4	/71	
		SLAVE BRANCH HIGHWAY DRIVER	MC-2016		2	/71	
	.3	INTERFACE/SYSTEM CONTROLLER TO HP2100, 2114, 2115, 2116	2201	BORER	NA	/71	(4)
	.7	INTERFACE FOR VARIAN 620I/L/F COMPUTER (PROGR,SEQUENT AND BLOCK TRANSFERS)	2204	BORER	NA	/72	
N		MICRODATA 800/CIP 2000 BRANCH DRIVER	91	JORWAY	NA	05/73	(7)
		BRANCH DRIVER (24BIT, PROGR, SEQUENT AND BLOCK TRANSFER MODES, MAX 7 CRATES)	5400	LABEN	4		
		H316/DDP516 CAMAC BRANCH HIGHWAY DRIVER (MEETS EUR 4600 SPECS)		MICRO CONSULTANTS	NA		
		INTERFACE FOR K202 COMPUTER	100	POLON	3	09/73	

.212 INTERFACES/DRIVERS FOR MULTICRATE SYSTEMS II (FOR OTHER PARALLEL MODE CONTROL/DATA HIGHWAY)

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.212	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	
		SEQUENTIAL COMMAND GENERATOR	7037-1		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	
		DATAWAY CONTROLLER PDP-8 (PART OF 7000-SER SYSTEM WITH EXT CONTROL HIGHWAY)	7048-2	NUCL. ENTERPRISES	2	/70	
		AUXILIARY CONTROLLER	7047-1		1	/70	
		DATA BREAK MODULE (USED WITH 7048)	CS 0009		1	/72	
		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	
		IBM 1130 INTERFACE SYSTEM (FOR HIGH SPEED DATA ACQUISITION, PROCESSING AND INTERACTIVE GRAPHICS, - COMPRISING	WDV 3300	WDV			
		INTERFACE CONTROL UNIT	WDV 1002		0		
		EXTENSION MODULE (MULTIPLEXER)	WDV 1060		0		
		PRIORITY MODULE	WDV 1008		0		
		MULTIPLEXER (DATA)	WDV 1133		0		

.213 INTERFACES/DRIVERS FOR SINGLE-CRATE SYSTEMS (4100 DATAWAY COMPATIBLE)

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.213	SINGLE CRATE CONTROLLER TO HP (CERN TYPE 066)	1531	BORER	2	/72	
		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	05/73	
		SINGLE CRATE SYSTEM CONTROLLERS(SEE EXECUTIVE SUITE, CLASS .211)		GEC-ELLIOTT			
N	.1	PDP-11-SERIES CRATE CONTROLLER	1304	BI RA SYSTEMS	2	02/73	
N		DEDICATED CRATE CONTROLLER FOR PDP-11 (MULTIPLE TRANSFER OR AUTO ADDRESS SCAN)	DC011	EG+G	2		(7)
		UNIBUS CRATE CONTROLLER PDP-11	3911	KINETIC SYSTEMS	2	/72	
		AUTONOMOUS CONTROLLER FOR PDP 11	9033	NUCL. ENTERPRISES	2	04/73	
N		CAMAC CRATE-PDP 11 INTERFACE	J CC 11	SAIP	2		(7)
		CRATE INTERFACE FOR PDP 8/I	J CPDP 8/I	SAIP	3	04/73	
N	.2	NOVA-SERIES CRATE CONTROLLER	1303	BI RA SYSTEMS	2	02/73	
N		NOVA TO SINGLE CRATE CONTROLLER	NCC-100	TECHCAL	3		
	.7	VARIAN-CAMAC INTERFACE CRATE CONTROLLER (16BIT SEQUENT+BLOCK TRANSF, 1 CC/CRATE)	C 300	INFORMATEK	2	/72	
		CONTROLEUR DE CHASSIS MULTI 8-CAMAC (24BIT,PROGR,SIMULT I/O,INTERRUPT MODES)	JCM 8	INTERTECHNIQUE	3	/71	
		CRATE INTERFACE FOR MULTI 8	J CM 8	SAIP	2	/72	
		CRATE CONTROLLER 320	C 72451-A6-A1	SIEMENS	3	/72	
		CRATE CONTROLLER 404	C 76451-A7-A1	SIEMENS	0		

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
		.214 CONTROLLERS FOR AUTONOMOUSLY OPERATED SYSTEMS (AND RELATED UNITS)					
	.214	INDEPENDENT PROCESSER	130	POLON	3	10/73	
		.217 OTHER PARALLEL MODE INTERFACES/DRIVERS/CONTROLLERS					
	.217	SYSTEM 3000 CONTROLLER (FOR DISTRIBUTED INTERFACE SYSTEM, PARALLEL MODE)	1552	BORER	2	/72	
		.22 INTERFACES/CONTROLLERS/DRIVERS FOR SERIAL HIGHWAY					
	.22	SYSTEM 3000 CONTROLLER (FOR DISTRIBUTED INTERFACE SYSTEM, SERIAL MODE)	1551	BORER	2	/72	(7)
		.23 UNITS RELATED TO 4600 BRANCH OR OTHER PARALLEL MODE CONTROL/DATA HIGHWAY --CRATE CONTROLLERS, TERMINATIONS,LAM GRADERS,BRANCH/BUS EXTENDERS					
	.23	DISPLAY DRIVER(CONTROLS 72A DISPLAY, ALSO CRATE CTR AND BRANCH DRIVER)	72A	JORWAY	5	/71	
		.231 CRATE CONTROLLERS (TYPE A-1, OTHER CC TYPES)					
N	.1	TYPE A-1 CRATE CONTROLLER	1301	BI RA SYSTEMS	2	02/73	
N		TYPE A-1 CRATE CONTROLLER AND TERMINATOR	1302	BI RA SYSTEMS	2	02/73	
		CRATE CONTROLLER /ESONE TYPE A1/ (CONFORMS TO EUR4600 SPECS)	1502	BORER	2	/72	
		CAMAC CRATE CONTROLLER TYPE A-1 (CONFORMS TO EUR4600 SPECIFICATIONS)	CC101	EG+G	2	/72	
		ESONE TYPE A-1 CRATE CONTROLLER (CONFORMS TO EUR 4600 SPECS)	CC 2405	GEC-ELLIOTT	2	01/73	
		CRATE CONTROLLER TYPE A-1 (CONFORMS TO EUR4600 SPECS)	CCA-1	JOERGER	2	/72	(5)
C		BRANCH CRATE CONTROLLER/TYPE A-1 (CONFORMS TO EUR 4600 SPECS, 1972)	70A	JORWAY	2	02/73	(7)
N		TYPE A-1 CRATE CONTROLLER	3900	KINETIC SYSTEMS	2	03/73	
		CRATE A CONTROLLER (CONFORMS TO EUR 4600 SPECS)	9016	NUCL. ENTERPRISES	2		(4)
		CRATE CONTROLLER TYPE A (CONFORMS TO EUR4600 SPECS)	C 106	RDT	2	/71	
		CONTROLEUR DE CHASSIS TYPE A-1 (CONFORMS TO EUR4600 SPECS)	J CRC 51	SAIP	2	/72	(1)
		A-1 CRATE CONTROLLER (CONFORMS TO EUR4600 SPECS, INCL CERN SPEC HOLD LINE)	ACC 2034	SEN	2	/72	
		CRATE CONTROLLER A (CONFORMS TO EUR 4600 SPECS)	C 72451-A1446-A2	SIEMENS	2	/70	(1)
C		TYPE A-1 (ESONE) CRATE CONTROLLER	CC-C1	TECHCAL	2	/72	(6)
N		CONTROLLER WITH TERMINATOR (MEETS 4600 SPECS OF JAN 1972)	CC-A1-BHT-003	TECHCAL	2		
	.7	CRATE CONTROLLER TYPE D (CONFORMS TO EUR 4100, USED WITH DO 280 COMPUTER SYSTEM)	DO 200-2901	DORNIER	2	/71	
C		CRATE CONTROLLER (3900 ECONOMY VERSION)	3901	KINETIC SYSTEMS	2	/72	
		.232 LAM GRADERS					
	.232	LAM GRADER (24 BIT MASK REGISTER, PLUG-IN PATCH BOARD, CERN 064)	LG 2401	GEC-ELLIOTT	1	/72	
N		LAM GRADER (INTERNALLY PATCHABLE)	LG	JOERGER	1	05/73	
N		LAM GRADER-SORTER	75	JORWAY	3	05/73	(7)
		LAM GRADER (DESIGNED TO EUR 4600 SPECS)	064	NUCL. ENTERPRISES	1	/72	(4)
		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)					
N	.1	BRANCH HIGHWAY TERMINATOR	6601	BI RA SYSTEMS	1	03/73	
		TERMINATION UNIT	1591	BORER	2	/71	
		TERMINATOR MODULE (BRANCH HIGHWAY TERMINATOR)	TC024	EG+G	2	/71	
		BRANCH HIGHWAY TERMINATION MODULE(MOUNTS DIRECTLY ON BRANCH HIGHWAY ASSEMBLY)	CD 18107	EMIHUS	NA	/72	

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
		BRANCH TERMINATION UNIT	BT 6601	GEC-ELLIOTT	2	/71	
		BRANCH TERMINATION UNIT (NON INDICATING)	BT 6503	GEC-ELLIOTT	2	/72	
		BRANCH TERMINATOR	BT	JOERGER	2	/72	
C		BRANCH TERMINATION WITH INTEGRAL CABLE	50C	JORWAY	2	/72	
N	.1	BRANCH TERMINATOR IN A CONNECTOR	BT-01	KINETIC SYSTEMS	NA	01/73	
		TERMINAISON DE BRANCHE CAMAC	J BT 20	SAIP	2	/71	
		CRATE CONTROLLER BUS TERMINATOR FOR A-1 CRATE CONTROLLER	BT 2042	SEN	1	/72	
N		BRANCH HIGHWAY TERMINATOR	BHT-001	TECHCAL	1		
N		BRANCH HIGHWAY TERMINATOR	BHT-002	TECHCAL	2		
	.2	BRANCH TERMINATION UNIT (LED DISPLAY WITH MEMORY)	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)	C 72451-A10-A1	SIEMENS	NA		(3)
N		TERMINATION DISPLAY OPTION (FOR BHT-001, BHT-002 AND CC-A1-BHT-003)	BHT-XXX/D	TECHCAL			

.234 BRANCH EXTENDERS, BUS EXTENDERS

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.1	DIFFERENTIAL BRANCH EXTENDER (FOR EXTENDING BRANCHES UP TO 3 KM)	DBE 6501	GEC-ELLIOTT	2	/71	
N		DIFFERENTIAL MODE BRANCH HIGHWAY EXTENDER (BI-DIRECTIONAL)	55	JORWAY	NA	06/73	(7)
		BRANCH HIGHWAY TRANSCEIVER FOR LONG DISTANCE TRANSMISSION	J BHT 10	SAIP	2		(4)
	.2	UNIBUS EXTENDER, TRANSMITTER RECEIVER (FOR DISTANCES UP TO 200 METRE OR MORE)	1594 1595	BORER	2 2	/72 /72	

.237 OTHER BRANCH OR HIGHWAY RELATED UNITS

.237 NO PRODUCTS IN THIS CLASS

.27 OTHER SYSTEM CONTROL RELATED GEAR INCL. SYSTEM-SYSTEM LINKS

.27 NO PRODUCTS IN THIS CLASS

3 TEST EQUIPMENT

.31 SYSTEM RELATED TEST GEAR

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

.311 COMPUTER SIMULATORS

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
C	.311	PDP-11 SIMULATOR	6101	BI RA SYSTEMS	NA	/72	(5)

.32 BRANCH RELATED TESTERS/CONTROLLERS AND DISPLAYS

.321 BRANCH TESTERS/CONTROLLERS (MANUAL, PROGRAMMED)

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.1	TEST MODULE (USED IN SYSTEM TEST OF READ/WRITE CAPABILITY)	TM024	EG+G	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)
		CHASSIS DE CONTROL MANUEL DE BRANCHE (COMPR TYPES CCOB10/TCMB10/TIC10/TIC20)	C CMB 10	SAIP	NA	/71	(1)
		ADDRESS SCANNER (MANUAL CONTROL OF CRATE OPERATIONS)	C-AS-20	WENZEL ELEKTRONIK	2	/72	

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
		.322 BRANCH DISPLAYS					
	.322	NO PRODUCTS IN THIS CLASS					
		.33 DATAWAY RELATED TESTERS AND DISPLAYS					
		.331 DATAWAY CONTROLLERS/TESTERS MANUAL, PROGRAMMED)					
N	.1	MANUAL CRATE CONTROLLER	1351	BI RA SYSTEMS	2	04/73	
		DATAWAY TEST MODULE (TESTS DATAWAY FOR OPEN LINES AND SHORTS)	DT086	EG+G	3	/72	
		MANUAL CRATE CONTROLLER	GFK-LEM	EISENMANN	8	/71	
		MANUAL CRATE CONTROLLER	MCC	JOERGER	5	/72	
		MANUAL DATAWAY CONTROLLER	7024-1	NUCL. ENTERPRISES	8	/70	
		CONTROLEUR MANUEL DE CHASSIS (MANUAL TEST MODULE)	J CMC 10	SAIP	8	/71	(1)
		DISPOSITIF DE CONTROLE MANUEL DE DATAWAY (MANUAL CONTROLLER/DISPLAY SYSTEM)	D AI 10	SAIP		/71	
		TIROIR DE PRISE D INFORMATION (INTERFACE TO DATAWAY)	J DA 10		1		
		CHASSIS DE CONTROLE ET AFFICHAGE (CONTROL AND DISPLAY CHASSIS)	C AI 10		NA		
		TEST MODULE FOR CRATE CONTROLLER AND DATAWAY	DTM 2040	SEN	1	/72	
		MANUAL 24 BIT CRATE CONTROLLER	MCC-240	TECHCAL	2	/72	(5)
	.2	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)
	.7	CONTROLEUR SORTIE DATAWAY (DATAWAY TEST MODULE)		TRANSRACK	1	/70	
		.332 DATAWAY DISPLAYS					
N	.1	CAMAC TEST MODULE/DATAWAY DISPLAY	6102	BI RA SYSTEMS	2	03/73	
		CAMAC DATAWAY DISPLAY (DATAWAY SIGNAL PATTERN STORED/DISPLAYED,2 TEST MODES)	1801	BORER	1	/71	(1)
N		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, FARWQXCIZS1S2BP1P2)	DD	JOERGER	1	/72	(6)
		DATAWAY DISPLAY	3290	KINETIC SYSTEMS	1	/72	
		DATAWAY DISPLAY	C 76451-A16-A1	SIEMENS	1		(6)
		DATAWAY DISPLAY MODULE	DD-001	TECHCAL	1	/72	(5)
		DATAWAY DISPLAY	C-D1-24	WENZEL ELEKTRONIK	1	/72	
	.2	DATAWAY DISPLAY (INDICATES LOGIC STATE OF DATAWAY LINES)	9019	NUCL. ENTERPRISES	NA	/71	(1)
		DATAWAY BUFFER (OUTPUTS TO 9019 DATAWAY SIGNALS ACCESSIBLE IN NORMAL STATION)	9018		1	/71	(1)
		.34 MODULE RELATED TEST GEAR (MODULE EXTENDERS)					
		.341 MODULE EXTENDERS					
	.341	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	
C							(4)
		EXTENSION UNIT	7007-1	NUCL. ENTERPRISES	1	/70	
		EXTENDER		POLON	1	04/73	
		EXTENDER	CEX	RDT	1	/72	
		MODULE EXTENDER	ME 2030	SEN	1	/70	
		EXTENDER (XXX=LENGTH OF CABLE IN MM BEYOND RACK)	CAMEX/XXX	TEKDATA	1	/72	(5)
		PROLONGATEUR POUR TIROIRS CAMAC (EXTENDER)		TRANSRACK	1	/70	
		.37 OTHER TEST GEAR FOR CAMAC EQUIPMENT					

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR

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

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.411	CRATE (270VA,COOLED,MODULAR POWERED BY UP TO 8 REGULATORS 1922 OR 1925+1922)	1902A	BORER	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			03/73	
		CRATES WITH DATAWAY AND POWER	1250-0006	DUCKERT	25	/71	
		CAMAC-RAHMEN MIT DATENWEG UND DREHSTROMNETZGERAET (POWERED CRATE)	1250-0021	DUCKERT	25	/72	
		CAMAC-RAHMEN MIT DATENWEG UND 220 V 50 HZ NETZGERAET (POWERED CRATE)	1250-0022	DUCKERT	25	/72	
		POWERED CRATE	MC100	EG+G	25	/71	
		CONVERTS FASTON CONNECTORS TO RECOMMEND-ED FIXED POWER CONNECTOR ON CHOSEN CRATE	/AMP	GEC-ELLIOTT		01/73	
		POWERED CRATE (+AND-6V/35A,+AND-12V/4A, +AND-24V/8A,200V/0.1A,117VAC, MAX 300W)	CPC/9	GRENSON	0		(6)
		POWERED CRATE (+AND-6V/25A,+AND-24V/6A)	CPU/8	GRENSON	24	/71	(2)
		POWER CRATE (7005-2 CRATE WITH 9022 POWER SUPPLY)	9023	NUCL. ENTERPRISES	24	/71	(2)
		CHASSIS ET TIROIRS AVEC ALIMENTATION (POWERED CRATE)		POLON	25	/71	
		CAMAC POWER SUPPLY (+AND- 6V/25A, +AND- 24V/6A)	AEC-432	POWER DESIGNS	25	/72	
		POWERED CRATE	CCHN-CSAN	RDT	25	/71	
		CHASSIS ALIMENTATION (POWERED CRATE, VENTILATED,+6V/25A,-6V/15A,+AND-24V/3A)	C JAL 40	SAIP	25	/71	
		POWERED CRATE(SEE P4 ALJ 13)	C4 ALJ 13 D	SAPHYMO-SRAT	25	/71	(1)
		POWERED CRATE(SEE P6 ALJ 13)	C6 ALJ 13 D		25		(1)
		POWERED CRATE(SEE P7 ALJ 13)	C7 ALJ 13 DW		25		(1)
		POWER SUPPLY (CAMAC CRATE)	CM5125/53/DW/BIP	SAPHYMO-SRAT	25	/72	
		POWER SUPPLY (CAMAC CRATE)	CM5125/53/AW/BIP		25		
		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 (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)
N		POWERED CAMAC CRATE (CONSISTING OF TYPES 1410S AND WCS)	PCS	TECHCAL	25		

.412 CRATES WITH DATAWAY, WITHOUT SUPPLY

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.412	CAMAC-RAHMEN MIT DATENWEG	1250-0001	DUCKERT	25	/72	
		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		[illegible]	[illegible]	
		CAMAC CRATE VERDRAHTET (EMPTY CRATE WITH WIRED DATAWAY)	2.084.000.6	KNUERR	25	/70	(2)
		UNPOWERED CRATE WITH F.P.C. DATAWAY	9	MB METALS	25	/72	
		CRATE WITH F.P.C. DATAWAY AND POWER RAIL ASSEMBLY	TYPES 1,2,5,6	MB METALS	25	/72	
		CRATE	7005-2	NUCL. ENTERPRISES	24	/70	
		CRATE WITH DATAWAY, NO POWER		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		

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
		UNPOWERED CRATE WITH DATAWAY AND CONNECTORS	UPC 2029	SEN	25	/70	
		CRATE (WIRED CRATE)	WCS	STND ENGINEERING	25		(5)
N		WIRED CAMAC CRATE	WCS	TECHCAL	25		

.413 CRATES WITHOUT DATAWAY, WITH SUPPLY

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.413	NO PRODUCTS IN THIS CLASS					

.417 BLANK CRATES AND OTHER COMPONENTS AND ACCESSORIES

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.417	CRATE WITH F.P.C. POWER RAIL ASSEMBLY	TYPES 3,4,7,8	MB METALS		/72	
N		CAMAC CRATE (EMPTY CRATE)	C	TECHCAL	25		
N		CAMAC CRATE KIT	CS		25		
	.1	CRATE (5U,EMPTY, 25 STATIONS)	MCF/5CAM/S/25	IMHOF-BEDCO	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	
		CRATE (6U EMPTY,WITH VENTILATION BAFFLE)	IB/9905-5HV1	OSL/IMHOF-BEDCO	25	01/73	
		FAN MOUNTING PLATE (FOR IB/9905-5HV1)	CAM/FM			01/73	
		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 DB/WV	NUCL. SPECIALTIES	25	/70	
		CAMAC CRATE	NSI 875 CC 100	NUCL. SPECIALTIES	25		(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	
		CHASSIS CAMAC POUR TIROIRS MODULAIRES, VIDES (EMPTY CRATES)		POLON	25	/71	
		VENTILATED CRATE NO POWER NO DATAWAY (TWO FANS)	CCHN	RDT	25	/71	
		(SAME WITH 3 FANS)	CCHNA		25	/72	
		CAMAC SYSTEM BIN (WITH MODULAR SUPPLY)		RO ASSOCIATES	25	/70	
		CRATE, EMPTY	C 76455-A3	SIEMENS	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	
		(460 MM DEEP)	CM 5025 40		25		
		(525 MM DEEP)	CM 5025 50		25		
		CHASSIS CAMAC 5U UTILES (EMPTY CRATE,6U TOTAL,360MM DEEP,VENTILATION HARDWARE)	CM 5125 30	TRANSRACK	25	/70	
		(460 MM DEEP)	CM 5125 40		25		
		(525 MM DEEP)	CM 5125 50		25		
		CHASSIS CAMAC 5U UTILES (EMPTY CRATE, TOTAL 6U,360 MM DEEP,WITH ONE FAN)	CM 5125 31	TRANSRACK	25	/70	
		(460 MM DEEP)	CM 5125 41		25		
		(525 MM DEEP)	CM 5125 51		25		
		CHASSIS CAMAC 5U UTILES (EMPTY CRATE,6U TOTAL,360MM DEEP,WITH TWO FANS)	CM 5125 32	TRANSRACK	25	/70	
		(460 MM DEEP)	CM 5125 42		25		
		(525 MM DEEP)	CM 5125 52		25		
		CAMAC CRATE (5U NON-VENTILATED,380 MM DEEP)	5UCAM	WILLSHER + QUICK	25	/71	(2)
		(6U VENTILATED,NO FAN,380 MM DEEP)	6UCAM		25		(2)
		(6U VENTILATED RECESSED,NO FAN,430 MM)	6URCAM		25		(2)
		CAMAC HEAVY DUTY CRATE (WITH DEPTH OPTIONS$ *=S FOR 380MM, *=E FOR 525MM, *=TP FOR 525MM 2-PIECE VERSION)		WILLSHER + QUICK			
		5U NON VENTILATED	HD5U CAM(*)		25	/72	(5)
		6U VENTILATED(**=G FOR ADDITIONAL GRILL)	HD6U CAM(*)**		25	/72	(5)
		7U VENTILATED(**=G FOR ADDITIONAL GRILL)	HD7U CAM(*)**		25	/72	(5)
	.2	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	
		VENTILATION UNIT	CAM/FV	IMHOF-BEDCO		01/73	

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
		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				
		FAN UNIT (FOR ALB/10 SUPPLY SYSTEM)	VALB/10	SAPHYMO-SRAT		/72	
		CRATE BLOWER UNIT		STND ENGINEERING			(5)
	.2	VENTILATION UNIT	1UVCAM	WILLSHER + QUICK		/71	(3)
		1U VENTILATION GRILL	1 UG	WILLSHER + QUICK		/72	
		2U VENTILATION GRILL	2 UG			/72	

.42 SUPPLIES AND RELATED COMPONENTS/ACCESSORIES -- SINGLE- AND MULTI-CRATE SUPPLIES,BLANK SUPPLY CHASSIS,CONTROL PANELS,SUPPLY VENTILATION

.421 MULTI-CRATE SUPPLIES

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.421	POWER SUPPLY FLEXIBLE SYSTEM COMPRISING	CPU/1	GRENSON		/71	
		BASIC CRATE(FOR SUPPLY MODULES,INCLUDES REFERENCE,CONTROL AND 200V/0.1A)	CFC				
		SUPPLY MODULE (+6V/6A)	CFP/6				
		(-6V/6A)	CFM/6				
		(+12V/3A)	CFP/12				
		(-12V/3A)	CFM/12				
		(+24V/3A)	CFP/24				
		(-24V/3A)	CFM/24)				
		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		12/73	(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	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.422	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			
		CAMAC POWER SUPPLY (+6V/20A,-6V/5A,+AND-24V/5A,200V/0.05A)	CPU/2	GRENSON		/71	
		SAME WITH SWITCHED METERING	CPU/2M			/71	
		POWER SUPPLY (+6V/20A,-6V/5A, +AND-12V/2A,+AND-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 (+6V/15A,-6V/4A,+AND-24V/2A +200V/0.05A NONSTABILISED, MAX 300W)	CZC-10	POLON		06/73	
		POWER UNIT (+6V/20A, -6V/15A,+24V/2A, -24V/2A,200V/0.1A)	SP 426	POWER ELECTRONICS			
		POWER SUPPLY (+6V/25A,-6V/5A, +AND-12V/2A,+AND-24V/3A,200V/0.1A)	C 303	RDT		/71	
		POWER UNIT(FOR SUPPLY MODULES)		RO ASSOCIATES		/71	
		CAMAC SYSTEM POWER SUPPLY MODULE (+AND-12V/72W, OR +12V/6A OR +24V/3A)	C 301			/70	
		(6V/10A)	C 210			/70	
		(6V/5A AND 24V/1A)	C 211			/70	
		(6V/5A, +12V/0.4A, -12V/0.4A)	C 213			/70	
		(12V/4A)	C 250			/71	
		(24V/2A)	C 251			/71	

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.422	POWER SUPPLY UNIT (+6V/10A,-6V/2A,+AND-24V/1.5A)	P4 ALJ 13	SAPHYMO-SRAT		/71	
		(+6V/5A,-6V/1.5A,+AND-12V/1.5A, +AND-24V/1.5A)	P6 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)
N		CAMAC POWER SUPPLY (+AND-6V/25A SHARED, +AND-24V/6A SHARED, METERING OF V AND I)	1410S	TECHCAL			
N		CAMAC POWER SUPPLY (PROVIDES STANDARD OUTPUTS OR TO USER SPECS, MAX 300W)	1510	TECHCAL			
N		POWER SUPPLY (+AND-6V/6A SHARED AND +AND-24V/2A SHARED, METERING OF V AND I)	825	TECHCAL			
	.427	BLANK SUPPLY CHASSIS, OTHER COMPONENTS/ACCESSORIES					
	.1	POWER SUPPLY CRATE (STANDARD)	MCF/4/PPC	IMHOF-BEDCO	NA	/71	
		POWER SUPPLY CRATE (WIRED)	MCF/PPC/WV		NA	/71	
		NETZTEILCHASSIS (EMPTY SUPPLY CHASSIS)	2.082.000.6	KNUERR		/70	
		POWER SUPPLY CRATE(FOR SEPARATE SUPPLY)	CSAN	RDT		/71	
	.2	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	
	.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)					
N	.1	BRANCH HIGHWAY CABLE	8102	BI RA SYSTEMS		02/73	
		BRANCH HIGHWAY CABLE	BH001	EG+G		/71	
		BRANCH HIGHWAY CABLE (COMPLETE PTFE CABLE ASSEMBLY,27CM LONG)	CD 18067-27	EMIHUS		/70	
		(1 METER LONG)	CD 18067/107			/71	
		(2 METERS LONG)	CD 18067/207			/71	
C		BRANCH HIGHWAY CABLE ASSEMBLY (WITH CONNECTORS,27 CM LONG)	CC 66 POL PB-27	EMIHUS		/71	
C		(XX CM LONG,PVC JACKET)	CC 66 POL PB-XX				
		BRANCH HIGHWAY CABLE (WITH CONNECTORS, 27 CM LONG)	BHC 027	GEC-ELLIOTT		/72	
		(SAME, 67 CM LONG)	BHC 067			/72	
		(SAME, 107 CM LONG)	BHC 107			/72	
		(SAME, 207 CM LONG)	BHC 207			/72	
		(OTHER LENGTHS TO SPECIAL ORDER)				/72	
C		BRANCH CABLE WITH CONNECTOR (1.5 FT TO 75 FT LONG)		JORWAY		/71	
		CABLE POUR BRANCH HIGHWAY (66 PAIRES TORSADEES,66 TWISTED PAIRS)	CL 90	SAIP		/71	
C		BRANCH HIGHWAY CABLE ASSEMBLY (COMPLETE WITH CONNECTORS, LENGTH 27 CM)	BHC 27	SEMRA-BENNEY		/72	
C		(SAME, XXX=LENGTH IN CM, 040,100 ETC)	BHC XXX			/72	
		BRANCH HIGHWAY CABLES(COMPLETE WITH CONNECTOR,XXX = LENGTH IN METERS)	2000/S/0132/XXX	TEKDATA		/71	(4)
C	.2	BRANCH HIGHWAY CONNECTOR (FIXED MEMBER,SOCKET MOULDING)	WSS0132S00BN000	EMIHUS		/70	
C		(FREE MEMBER,PIN MOULDING, PXX YYY SELECTS JACKSCREW)	WSS0132PXXBNYYY				
C		HOOD (FOR FREE MEMBER)	WAC 0132 H005				
C	.3	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	
		CABLE FOR BRANCH HIGHWAY (PVC JACKET)	132 PE 189	PRECICABLE BOUR		/71	
		(BRAIDED RILSAN JACKET)	132 PE 210				
		(MEPLAT 20MMX10.8MM,GAINE PVC NOIR)	132 PE 291			/72	
	.7	CABLE EXTENSION MODULE (JOINS TWO BRANCH HIGHWAY CABLES)	CD 18106	EMIHUS		/72	

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.432	DATAWAY RELATED (CONNECTORS, BOARDS, ASSEMBLIES)					
N	.432	DATAWAY MOTHERBOARD	DM-1	TECHCAL			
	.1	DATAWAY ASSEMBLY (FILM WIRE PACKAGING)		MB METALS		/71	(3)
		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	
	.3	DATAWAY CONNECTOR, EDGE TYPE II	163633	AMP-HOLLAND		/70	
		DATAWAY CONNECTOR,FLOWSOLDER TERMINATION (ADD MOUNTING BRACKETS R500014900000000)	R500014800000000	CARR FASTENER		/70	
		MINI WRAP TERMINATION	R500016800000000			/70	
		SOLDER SLOT TERMINATION				/70	
C		DATAWAY CONNECTOR (MINIWRAP)	EAA 043 D301	EMIHUS		/71	(2)
		CONNECTEUR,FUTS DROITS (DATAWAY CONNECTOR,STRAIGHT PINS)	KF86 254 BED T	FRB CONNECTRON		/70	
		FUTS WRAPPING (WIRE WRAP PINS)	KF86 254 BEY T				
		FUTS A SOUDER (SOLDER PINS)	KF86 254 BES T				
		CAMAC DATAWAY CONNECTOR	G 03·	ITT CANNON			(6)
		CAMAC-LEISTE(DATAWAY CONNECTOR,MINIWRAP)	4.000.000.0	KNUERR		/70	
		(SOLDER PINS)	4.000.001.0				
		DATAWAY CONNECTOR,MINI-WRAP	2422 061 64334	PHILIPS		/71	(5)
		BOARD SOLDER	2422 061 64354				(5)
		WIRE-SOLDER	2422 061 64314				(5)
		DATAWAY MALE CONNECTOR (MATING THE CRATE MOUNTED 86-WAY CONNECTOR SOCKET)	2422 060 14314	PHILIPS			(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, PATCHBOARS ETC)					
	.11	BLANK MODULE KIT (SINGLE WIDTH)	BM 1	GEC-ELLIOTT	1	01/73	
		(DOUBLE WIDTH)	BM 2		2		
		NEW SIMPLIFIED (TRIPLE WIDTH)	BM 3		3		
		DESIGN (QUADRUPLE WIDTH)	BM 4		4		
		SINGLE CARD MOUNTING KIT (EMPTY MODULE)	BCK/5CAM/CM1	IMHOF-BEDCO	1	/71	
		DOUBLE CARD MOUNTING KIT	BCK/5CAM/CM2		2		
		TRIPLE CARD MOUNTING KIT	BCK/5CAM/CM3		3		
		QUADRUPLE CARD MOUNTING KIT	BCK/5CAM/CM4		4		
		DOUBLE ENCLOSED BIN KIT (EMPTY MODULE)	BCK/5CAM/BM2	IMHOF-BEDCO	2	/71	
		TRIPLE ENCLOSED BIN KIT	BCK/5CAM/BM3		3	/71	
		QUADRUPLE ENCLOSED BIN KIT	BCK/5CAM/BM4		4	/71	
		SINGLE CARD MOUNTING KIT (EMPTY MODULE, SHORT SCREEN PLATE)	CAM/M1/A	IMHOF-BEDCO	1	/72	
		(SAME WITH LONG SCREEN PLATE)	CAM/M1/B		1	/72	
		DOUBLE CARD MOUNTING KIT (EMPTY MODULE, SHORT SCREEN PLATE)	CAM/M2/A		2	01/73	
		(SAME WITH LONG SCREEN PLATE)	CAM/M2/B		2	01/73	
		TREBLE CARD MOUNTING KIT (EMPTY MODULE, SHORT SCREEN PLATE)	CAM/M3/A		3	01/73	
		(SAME WITH LONG SCREEN PLATE)	CAM/M3/B		3	01/73	
		QUADRUPLE CARD MOUNTING KIT (EMPTY MODULE WITH SHORT SCREEN PLATE)	CAM/M4/A		4	01/73	
		(SAME WITH LONG SCREEN PLATE)	CAM/M4/B		4	01/73	
		CAMAC HARDWARE	CH-001	KINETIC SYSTEMS	1	/71	(4)
		CAMAC-KASSETTE (EMPTY MODULE,WIDTH 1/25)	2.090.001.8	KNUERR	1	/70	(2)
		(WIDTH 2/25)	2.090.002.8		2		
		(WIDTH 3/25)	2.090.003.8		3		
		(WIDTH 4/25)	2.090.004.8		4		
		(WIDTH 5/25)	2.090.005.8		5		
		(WIDTH 6/25)	2.090.006.8		6		
		MODULE KIT (EMPTY MODULE,1 UNIT WIDTH)	9005-1	NUCL. ENTERPRISES	1	/71	
		(EMPTY MODULE,2 UNIT WIDTH)	9005-2		2	/71	

NC	CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	.11	CAMAC COMPATIBLE MODULE	NSI 875 DM	NUCL. SPECIALTIES	1	/70	
		(EMPTY MODULE,1 UNIT WIDTH)					
		(2 UNIT WIDTH)			2		
		(3 UNIT WIDTH)			3		
		CAMAC MODULE (EMPTY MODULE HARDWARE, SPACERS ESTABLISH MODULE WIDTH)	NSI 875 CM-100	NUCL. SPECIALTIES			(5)
		TIROIR MODULAIRE (W=1/25)	9905-1-L	OSL	1	/71	
		(W=2/25)	9905-2-L		2	/71	
		(W=3/25)	9905-3-L		3	/71	
		(W=4/25)	9905-4-L		4	/71	
		(W=5/25)	9905-5-L		5	/71	
		(**=06,08,10 AND 12 FOR CORRESP WIDTH)	9905-**-L			/71	
		TIROIR MODULAIRE A CARTES BASCULANTES (EMPTY MODULE WITH HINGED CARDS, W=2/25)	9905-TCB2	OSL	2	/71	
		(SAME, W=3/25)	9905-TCB3		3	/71	
		EMPTY MODULE, 1 UNIT		POLON	1	/71	
		(2 UNITS)			2		
		(3 UNITS)			3		
		(4 UNITS)			4		
		EMPTY MODULE 1 UNIT	CCA 1	RDT	1	/70	
		2 UNITS	CCA 2		2		
		3 UNITS	CCA 3		3		
		4 UNITS	CCA 4		4		
N		EMPTY MODULE SCREENED (1 WIDE, ADD TYPE SUFFIX A FOR SHORT, B FOR LONG SCREENS)	CM1	SEMRA-BENNEY	1	02/73	
N		(DITO, *=2,3,4 OR 6 FOR CORRESP WIDTH)	CM*				
		MODULE HARDWARE (EMPTY MODULE, W=1/25)		STND ENGINEERING	1		
		(W=2/25)			2		
		(W=3/25)			3		
		(WIDTHS UP TO 8/25)					
		TIROIR MODULAIRE (EMPTY MODULE,W=1/25)	TM 50125	TRANSRACK	1	/70	
		(W=2/25)	TM 50225		2		
		(W=3/25)	TM 50325		3		
		(W=4/25)	TM 50425		4		
		(W=5/25)	TM 50525		5		
		(**=06,08,10 AND 12 FOR CORRESP WIDTH)	TM 5**25				
		CAMAC MODULE (EMPTY,1/25 CARD MODULE)	CAMCAS 1	WILLSHER + QUICK	1	/71	(2)
		(2/25)	CAMCAS 2		2	/71	(2)
		(3/25)	CAMCAS 3		3		(2)
		(4/25)	CAMCAS 4		4		(2)
		CAMAC MODULE (EMPTY,1/25 CARD MODULE)	CAMCAS 1-G	WILLSHER + QUICK	1	/72	
		(2/25)	CAMCAS 2-G		2	/72	
		(3/25)	CAMCAS 3-G		3	/72	
		(4/25)	CAMCAS 4-G		4	/72	
		CAMAC MODULE(EMPTY,1/25 SCREENED MODULE)	CAMMOD 1-G	WILLSHER + QUICK	1	/72	
		(2/25)	CAMMOD 2-G		2	/72	
		(3/25)	CAMMOD 3-G		3	/72	
		(4/25)	CAMMOD 4-G		4	/72	
		CAMAC MODULE(EMPTY,2/25 SCREENED MODULE)	CAMMOD 2	WILLSHER + QUICK	2	/71	(2)
		(3/25)	CAMMOD 3		3		(2)
		(4/25)	CAMMOD 4		4		(2)
	.12	TIROIR MODULAIRE POUR COMMANDE	9905-TC-1	OSL	1	/71	
		TIROIR MODULAIRE DE COMMANDE (SUPPLY CONTROL MODULE)	TCM 525	TRANSRACK	1	/70	
	.2	CAMAC PRINTED CARD		KNUERR			(5)
N		MATRIX BOARD (DOUBLE SIDED, FOR PROTO-TYPE WIRING OF 14,16,24 AND 40 PIN DIL)	EB5/1159	NUCL. ENTERPRISES			
N		DECODED MATRIX BOARD (FOR PROTOTYPE WIRING, 64 14-PIN SITES,A AND F DECODED)	D20654				
		CARTE CIRCUIT IMPRIME CAMAC (PRINTED CIRCUIT BOARD FOR CAMAC MODULE)		TRANSRACK	NA	/70	
N	.3	MK-1 KLUGE MODULE (131 MIXED 14, 16, 24 PIN SOCKETS)	8301	BI RA SYSTEMS	2	01/73	
N		MK-2 KLUGE MODULE (SIMILAR TO 8301 WITH DECODING)	8302		2	01/73	
N		MK-4 KLUGE MODULE (TO USE 3 CASH CARDS/WITH DECODING)	8304		2	01/73	
		CAMAC-UNIVERSALKARTE (PRINTED CARD MODULE 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	GSPK	NA	/70	(2)
		PRINTED CIRCUIT TEST BOARD	10	JORWAY	NA	/71	
		KLUGE CARD (FOR CREATING YOUR OWN CAMAC MODULES)	2000	KINETIC SYSTEMS	1	/71	(4)

NC CODE	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
.3	EXPERIMENTIERPLATTE (PRINTED CIRCUIT BOARD)	4.000.002.0	KNUERR	NA	/70	
	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 OV 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	0		
	BLANK MODULE WITH 60 WIRE-WRAP SOCKETS	WW-001	TECHCAL	2	/72	
	BLANK MODULE WITH 56 WIRE-WRAP SOCKETS AND COMPLETE DECODING OF A AND F LINES	WW-002		2	/72	
	.437 OTHER RECOMMENDED OR STANDARD COMPONENTS/ACCESS.					
.1	NIM ADAPTOR	7009-2	NUCL. ENTERPRISES	NA	/70	
	NIM-CAMAC ADAPTOR	CAN	RDT	NA	/71	
	NIM/CAMAC ADAPTOR	ANC 10	SAIP		/72	
	CAMAC NIM ADAPTOR	CNA 2033	SEN	2	/71	
.21	LAM GRADER CABLE (20CM, WITH CONNECTORS)	LGC 20	GEC-ELLIOTT		/72	
	(40CM, WITH CONNECTORS)	LGC 40			/72	
.22	52-WAY DOUBLE DENSITY CONNECTOR (FIXED MEMBER WITH PINS.LAM GRADER CONNECTOR)	2 DB 52 P	ITT CANNON		/70	
.3	COAXIAL CONNECTOR	RA 00 C50	LEMO		/70	(4)

Note

Manufacturers requiring their new products to appear in the PRODUCT GUIDE Section or intending to complete or correct information presented already should submit data on each item separately and, preferably, in the format used in this issue.

INDEX OF MANUFACTURERS

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

AMP-Holland N.V.
Papierstraat 2-4, Postbus 288
'S-Hertogenbosch, Netherlands

C Benney—See Semra-Benney

Berthold/Frieseke – See BF Vertrieb

BF Vertrieb GmbH
Bergwaldstrasse 30, Postfach 76
D-7500 Karlsruhe 41, Germany

C BI RA Systems, Inc.
9617 Acoma Road, S.E.
Albuquerque, N. Mex. 87123, USA

Borer Electronics AG
Postfach 4500
CH-4500 Solothurn 2, Switzerland

Cannon Electric GmbH
Postfach 1120
D-7056 Beutelsbach, Germany

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

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

Dornier AG
Vertrieb Elektronik, Abt. VC 20
Postfach 317
D-799 Friedrichshafen, Germany

Duckert – See Juergen Duckert

EG+G Inc.
Nuclear Instrumentation Division
500 Midland Road
Oak Ridge, Tenn. 37830, USA

Eisenmann Elektronische Geräte
Blumenstrasse 11
D-7500 Karlsruhe, Germany

EKCO – See Nuclear Enterprises

Elliott – See GEC-Elliott

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

C Emihus Microcomponents Limited,
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

Frieseke – See BF Vertrieb

GEC-Elliott Process Automation Ltd.
Camac Group, New Parks
Leicester LE3 1UF, England

Grenson Electronics Ltd.
Long March Industrial Estate
High March Road
Daventry, Northants NN11 4HQ,
England

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

Hans Knuerr KG
Ampfingstrasse 27
D-8000 München 8, Germany

Hewlett-Packard (Schweiz) AG
7, Rue du Bois-du-Lan
CH-1217 Meyrin-Genève, Switzerl.

Hytec Electronics
225 Courthouse Road
Maidenhead, Berkshire, England

Imhof-Bedco Ltd.
Ashley Works, Ashley Road
Uxbridge
Middlesex UB8 2SQ, England

Informatek
Z.I. de Bures/Orsay, B.P. 12,
F-91401 Orsay, France

Intertechnique
F-78 Plaisir, France

ITT Cannon – See Cannon

J and P Engineering (Reading) Ltd.
Portman House
Cardiff Road
Reading, Berkshire R61-8JF, England

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

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

Juergen Duckert Projekttechnik
Adam-Berg Strasse 5
D-8000 München 83, Germany

C 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

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

Lemo SA
CH-1110 Morges, Switzerland

Leonische Drahtwerke AG
Abholfach
D-8500 Nurnberg 2, Germany

LRS-Le Croy – See Le Croy

MB Metals Ltd.
Victoria Road
Portslade, Sussex BN4 1YH, England

Micro Consultants Ltd.
Interface House
Croydon Road
Caterham, Surrey, England

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

OSL — See Société Outillage

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 – See Zjednoczone

Precicable Bour
151, Rue Michel-Carre
F-95101 Argenteuil, France

Power Designs Inc.
European Agent Chronetics Inc.
39 Rue Rothschild
CH-1202 Geneva, Switzerland

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

RDT Ing. Rosselli Del Turco
Rossello S.L.R.
Via di Tor Cervara, 261
Casella Postale 7207
Roma Nomentano,
I-00155 Rome, Italy

RO Associates Inc.
3705 Haven Avenue, P.O. Box 2163
Menlo Park, Calif. 94025, USA

C SABCA—See Emihus, Belgian
Branch

Saip/Schlumberger
Boîte Postale 47
F-92222 Bagneux, France

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

C Semra-Benney (Electronics) Ltd.
Industrial Estate,
Chandler S Ford, Eastleigh,
Hampshire SO5 3ZU, England

SEN Electronique
31, Avenue Ernest Pictet, C.P. 57
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

Société Outillage Scientifique et
de Laboratoire (OSL)
4, Avenue du Château
F-06 La Trinité, France

Souriau et C^{ie}
13, Rue Gallieni, B. P. 410
F-92 Boulogne-Billancourt, France

Standard Engineering Corporation
44255-1 Fremont Blvd,
Fremont, California 94538, USA

Tech and Tel – See Technograph

Techcal Electronic Services Ltd.
2346 Spruce Street
Vancouver 9, B.C., Canada

Technograph and Telegraph Ltd.
Easthampstead Road
Bracknell, Berkshire, England

Tekdata Ltd.
Pentagon House
Bucknall New Road, Hanley
Stoke on Trent, Staffs. ST1 2BA,
England

Telefunken – See AEG-Telefunken

C TMA Electronics—See BI RA Systems

Transrack
22, Avenue Raspail, B.P. 12
F-94 Saint-Maur, France

Ultra Electronics (Components) Ltd.
Fassetts Road
Loudwater, Bucks., England

Wallac Instruments Ltd.
Crown House, Theale,
Reading, England

Wissenschaftliche
Datenverarbeitung GmbH
Zeppelinstrasse 11
D-8046 Garching bei München,
Germany

Wenzel Elektronik
Lamontstrasse 32
D-8000 München 80, Germany

Willsher and Quick Ltd.
Walrow
Highbridge, Somerset, England

Zjednoczone Zaklady Urzadzen
Jadrowych Polon, Bjuro Zbytu
Warszawa, Poland

CAMAC BIBLIOGRAPHY

Specifications and Supplementary Information*

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

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

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

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

CAMAC: Supplementary Information on CAMAC Instrumentation System. AEC Report TID-25877, USAEC, Washington DC and Supplement to *CAMAC Bulletin* No. 6, CEC, Luxembourg.

Recommended Introductory Reading

ESONE: Organisation and Structure of the ESONE Commitee, Oct. 1970, Ispra.

TRADOWSKY-THAL, I. CAMAC Bibliography. Karlsruhe Reports KFK 1471 (1971), KFK 1671 (1972).

BARNES, R.C.M. and WHITEMAN, A.R.C. CAMAC Bibliography. *Harwell Report* AERE-Bib 180 (1972).

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

ATTWENGER, W., PATZELT, R. CAMAC-Computer Control Equipment System. *'Isotope in Industrie und Landwistschaft'*. No. 2/70. SGAE, Vienna.

BISBY, H. The CAMAC Interface and some Applications. *The Radio and Electronic Engineer*, **41**, 12 (1971).

BRANTL, K., SVOBODA, A. Nová modulová přistrojová stavebnice, určená pro přístroje jaderné techniky (New Modular System Conception of Nuclear Instrumentation, based on the CAMAC System). *Jaderna Energie*, **17**, p. 345 (1971).

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

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

OTTES, J. and TRADOWSKY, K. Das CAMAC-System Rechner geführter Elektronik, Einführung und heutiger Stand. *Atomwirtsch. - Atomtechn.*, **16**, p. 516 (1971).

ISELIN, F. *et al.* Introduction to CAMAC. CERN, Report CERN-NP CAMAC Note 24-00 (1971).

VOJINOVIC, M. Sistem Nuklearnih Instrumenata za Rad sa Računskim Mašinama CAMAC (in Kroat). *Nuklearna Energija*, **6** (1971). No. 1, p. 19.

DE AGOSTINO, E., RISPOLI, B. Il Systema CAMAC. *Notiziario CNEN*, (18) **2**, 1972.

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

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

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

Other Recent References**

BUCHANAN, J.A. Rice University Microprogrammed CAMAC/PDP-11 Data-acquisition System. Proceedings of the LAMPF summer study session. Los Alamos, New Mexico, August 9-14, 1971. LA-4824. Nov. 1971, p. 181-184.

MEYER, J.M., PERRIN, M., MLYNEK, D., LEHMANN, M., METZGER, G. CAMAC System Controller. (in French). *Nucl. Instrum. Methods*, *103*, No. 3, 601-6 (1972).

ELIZAROV, O.I., ZHUKOV, G.P. Program Controller in the Standard CAMAC (in Russian). Joint Inst. for Nuclear Research, Dubna, USRR. Lab. of Neutron Physics. 1972, p. 9, Dep NTIS (U.S. Sales only).

BESANT, C.B., JEBB, A., HAMLYN, A. *et al.* CAMAC 11. A Fully Interactive Computer Aided Design System. *Computer Aided Design.*, *4*, No. 5, Oct. 1972.

MACK, Dick A. New Technologies. Lawrence Berkeley Laboratory Report LBL 1312 (1972). Presented to Business & Environment Seminar, Disney World, Florida, Oct. 16-20, 1972.

BISWELL, L.R., RAJALA, R.E. A Microprogrammed Branch Driver (MBD) for a PDP-11 Computer. Los Alamos University of California, Report LA-4916-MS, UC-32, April 1972.

MACK, D.A. CAMAC Concepts, *Astronomical Society of the Pacific Publication*, **84**, Feb. 1972, p. 167.

VAN BREDA, I.G. CAMAC Multicrate Systems, *Astronomical Society of the Pacific Publication*, **84**, Feb. 1972, p. 212.

GALLICE, P. Informations sur le Système CAMAC. Commissariat à l'Énergie Atomique, Report SES/SESG/SEG/R-3051/PG (1971).

ADAMS P., Beamline Computer Control by Interpreter. *IEEE Trans. Nucl. Sci.*, **18** (1971), No. 3, p. 361.

DOUGLASS, T.D. NIM and CAMAC Prove Feasibility of Standard Instrument Modules. *Res./Dev.*, **22** (1971), No. 11, p. 20.

BERTOLUCCI, B., HORELICK, D., ROSCHE, F. CAMAC Discriminator-Gated Latch with Digital Multiplicity Logic, 'TITO'. *IEEE Trans. Nucl. Sci.*, **19** (1972), No. 1, p. 526.

BUCHANAN, J.A., JONES, H.V. CAMAC Multi-Microprogrammed I/0 Processor. *IEEE Trans. Nucl. Sci.*, **19** (1972), No. 1, p. 682.

DHAWAN, S. YALE-NAL CAMAC System. *IEEE Trans. Nucl. Sci.*, **19** (1972), No. 1, p. 689.

OAKES, A.E. A Microprogrammable CAMAC Branch/Driver/Controller. *IEEE Trans. Nucl. Sci.*, **19** (1972), No. 1, p. 696.

HALLING, H., ZWOLL, K., MÜLLER, K.D. Versatile PDP-11 CAMAC Crate Controller for Nuclear Data Acquisition and Processing. *IEEE Trans. Nucl. Sci.*, **19** (1972), No. 1, p. 699.

FREYTAG, D. A Simple CAMAC System. *IEEE Trans. Nucl. Sci.*, **19** (1972), No. 1, p. 719.

DHAWAN, S. On the Design of CAMAC Branch Drivers. *IEEE Trans. Nucl. Sci.*, **19** (1972), No. 1, p. 721.

BORCHERDING, K., GRUBER, P., OTTES, J., TRADOWSKY, K. CAMAC-50-MHz-Zähler-Modul Typ LEM-52/1.6. Spezifikation und Beschreibung. Kernforschungszentrum Karlsruhe. Report KFK 1467 (1972).

TRADOWSKY, K. CAMAC - Ein System rechnergefürter Elektronik. Nr. 3 Internationaler Kongress "Datenverarbeitung im Europäischen Raum". Kongress Dokumentation. Wien, Johanna Metek (1972), *2*, p. 287.

ATTWENGER, W. Industrielle Prozesserfassung, CAMAC-System im Einsatz. Nr. 3. Internationaler Kongress "Datenverarbeitung im Europäischen Raum". Kongress Dokumentation. Wien, Johanna Metek (1972), *2*, p. 293.

COLLINS, G.B., KEATS, A.B. Experience in the Use of a Standard Computer Interface for Laboratory Automation Systems. Trends in On-Line Computer Control Systems, IEE Conf. Publ. No. 85, London; IEE (1972), p. 40.

ATTWENGER, W. Some Recent Implementations of Computer Control in Austria Using a Standard Interface (CAMAC). Trends in On-Line Computer Control Systems. IEE Conf. Publ. No. 85, London; IEE (1972), p. 117.

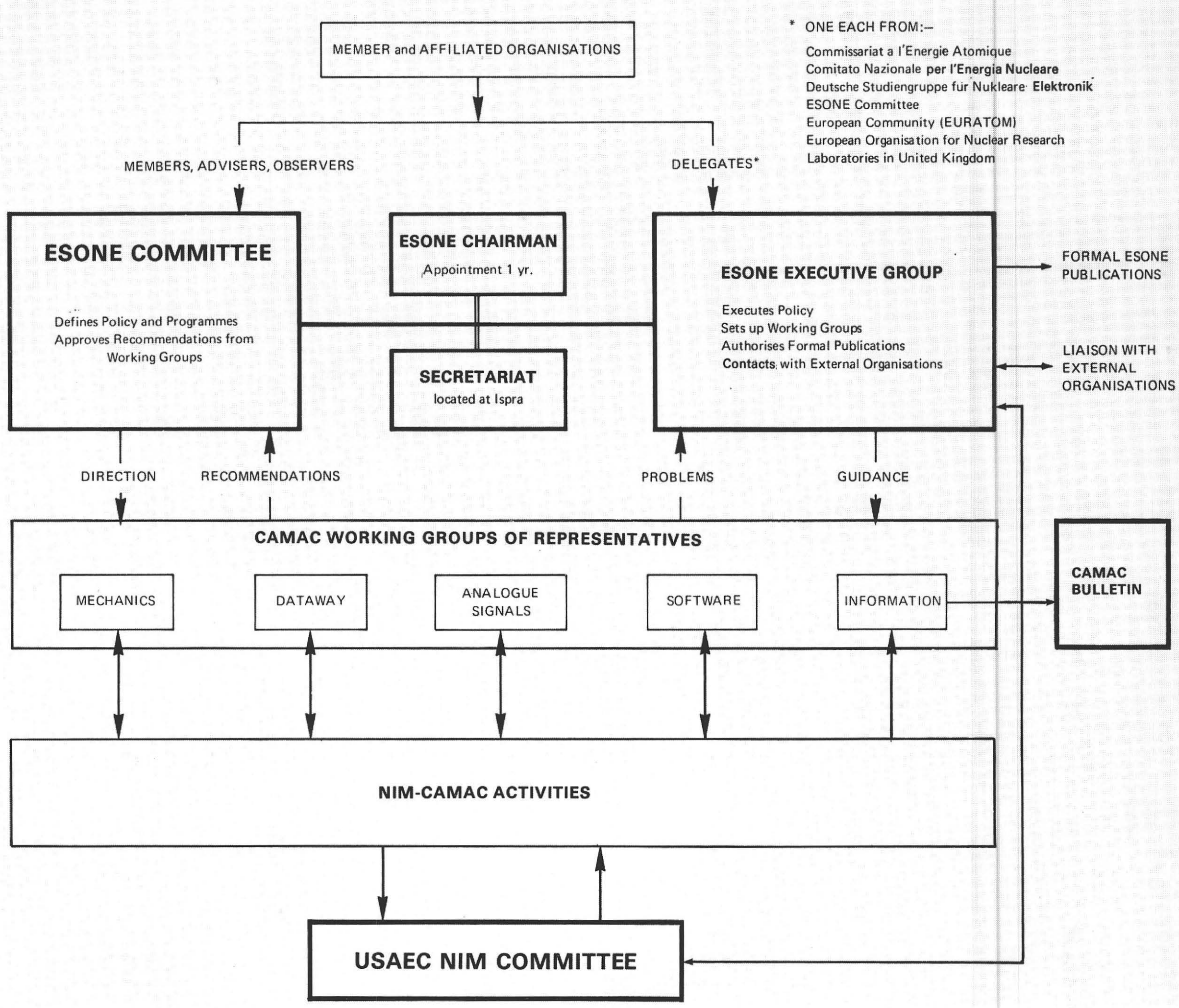
PEATFIELD, A.C. The Potential of a Standard Highway-Interface (CAMAC) for Computer Systems in Real-Time Applications. Trends in On-Line Computer Control Systems. IEE Conf. Publ. No. 85, London; IEE (1972), p. 142.

OTTES, J.G. CAMAC - Ein System rechnergeführter Elektronik. Zentrale Steuerung für Datenendstelle. *Elektronik*, **21** (1972), p. 169.

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

** Publications in the more recent CAMAC Bulletin issues are listed on the rear cover of this issue.

ESONE ORGANIZATION AND CAMAC ACTIVITIES



SUBSCRIPTION FEES

For one copy per issue and three issues per annum[1] . . . . **B. Fr. 300.-**[2,3]
single copies . . . . **B. Fr. 125.-**[2]

Quantity discount for bulk orders.[4]

10 to 25 copies : 20%
more than 25 copies: 30%

On special request, orders can be sent by air-mail, and the freight charges will be invoiced at cost.

FEES FOR REPRINTS[5]

Number of pages up to		4 pages	8 pages	16 pages	32 pages
25 reprints	B. Fr.[2]	390	625	1 245	2 490
Additional lots of 25	B. Fr.[2]	25	30	60	120

(Any blank pages necessary to complete printer's form are counted as printed.)

[1] Subscription period starts on January 1st and ends on December 31st.
[2] Or the equivalent value in another currency.
[3] Students, universities, study and research centres and associated members may receive a reduction of 30% on the subscription price, if requested. An additional quantity discount of 10% is granted for bulk orders of 10 copies and more and of 15% for more than 25 copies.
[4] Quantity discounts and (or) reductions are granted only for direct orders to the Commission of the European Communities.
[5] Orders should be submitted to the address given on the reply cards.