CAMAC

bulletin

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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*

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* *DEADLINES FOR SUBMISSION* **(issue No. 10)**
For articles and New Products: 18.2.74
For Short News: 15.4.74
For Product Guide: 13.5.74

On the cover: View of Capitolium in Rome where in 1957 the first six Members of the European Communities signed the "Treaty of Rome". The ESONE Committee held its Annual General Assembly at Rome in 1968.

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Correspondence to:

the Secretary of the
ESONE Committee
W. Becker, JRC Euratom
I-21020 Ispra (Va) Italy

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KOMMISSION
DER EUROPÄISCHEN GEMEINSCHAFTEN

RALF DAHRENDORF
MITGLIED DER KOMMISSION

RUE DE LA LOI 200
1040 BRÜSSEL

Liebe Leser,

Die Kommission der Europäischen Gemeinschaften fördert seit langer Zeit die Tätigkeit des ESONE Komitees. Mit Befriedigung kann sie heute feststellen, dass diese Entscheidung richtig war. Die CAMAC-Vereinbarungen - wichtigste Initiative des ESONE Komitees in den letzten Jahren - sind weithin bekannt und werden in vielen Anwendungsbereichen mit Erfolg berücksichtigt. Diese Entwicklung wurde in den letzten drei Jahren nicht unwesentlich beeinflusst durch die Herausgabe des CAMAC-Bulletins, welches das ESONE Komitee mit Unterstützung der Kommission der Europäischen Gemeinschaften veröffentlicht.

Als das für Forschung, Wissenschaft und Bildung verantwortliche Kommissionsmitglied begrüsse ich das Ziel, welches mit der Herausgabe des CAMAC-Bulletins verfolgt wird:

Verbreitung der für die Anwendung in Kernforschungszentren erarbeiteten Methoden zur Automatisierung von Mess-, Steuerungs- und Regelvorgängen, um sie in anderen Bereichen der wissenschaftlichen Forschung, in der Industrie und für öffentliche Dienste nutzbar zu machen.

Dieses Ziel steht in Einklang mit den entschiedenen Bemühungen der Kommission, im Rahmen ihrer Wissenschafts- und Technologiepolitik alle Möglichkeiten der Informationsverbreitung auszuschöpfen.

Wichtige weitere Voraussetzungen für einen erfolgreichen weltweiten Informationsaustausch sind nach meiner Überzeugung Gedankenaustausch und persönliche Kontakte auf übernationaler Basis. Das gilt auch für die Verbreitung von CAMAC. Ein erster Schritt in diese Richtung ist das "First International Symposium on CAMAC in Real-Time Computer Applications", welches die Kommission der Europäischen Gemeinschaften in Zusammenarbeit mit dem ESONE Komitee vom 4. -6. Dezember 1973 in Luxemburg veranstaltet.

Ich wünsche der Veranstaltung einen erfolgreichen Verlauf und kann Ihnen versichern, dass die Kommission auch weiterhin bemüht sein wird, Initiativen zur Förderung von CAMAC wirkungsvoll zu unterstützen.

Ralf Dahrendorf
Mitglied der Kommission

Dear Reader,

For some time now the Commission of the European Communities has supported the activities of the ESONE Committee. It is with satisfaction that the Commission is now able to conclude that the decision to do this was right. The CAMAC Standard—the most important development and work of the ESONE Committee during recent years—is now well known far and wide and successfully used in many areas of application. This expansion has been directly influenced during the last 3 years by the CAMAC Bulletin, a publication of the ESONE Committee supported by the Commission.

As the Member of the Commission responsible for Research, Science and Education, I welcome the aims of the Bulletin, which are to diffuse into other areas methods for the automation of measurement and control that were developed for applications in the Nuclear Research Centres and to promote useful applications in scientific research, industry and in public services.

These aims are in agreement with the policies of the Commission in science and technology and its determination to use all possible methods for dissemination of information.

I believe that another important condition for a successful world-wide exchange of information is based on the exchange of ideas and personal contacts between people from many nations. This certainly applies to the promotion of CAMAC and a first step of this kind is the 1st International Symposium on CAMAC in Real-Time Computer-Applications which is being organised by the Commission, in collaboration with the ESONE Committee, for 4-6 December 1973 in Luxembourg.

I wish this conference to be a great success and I assure you that the Commission will be anxious to further support initiatives for the promotion of CAMAC.

Ralf Dahrendorf
Member of the Commission

Ralf Dahrendorf

BIOGRAPHICAL NOTE

Born 1929. Studied philosophy and classical philology.
Degrees of Doctor of Philosophy (Hamburg) and Ph.D. (London).
Ordinary Professor for Sociology at the Universities of Hamburg, Tübingen and Konstanz.
Guest Professor at different universities in America, England, Netherlands, Czechoslovakia and Switzerland.
Since 1969, Member of the German Bundestag and Parliamentary State Secretary in the Ministry of Foreign Affairs.
Since July 1970, Member of the Commission of the European Communities, responsible for Research, Science and Education.

INTRODUCTION TO CAMAC

1

MODULARITY AND CAMAC

by

H. Bisby

E & AP Division, AERE Harwell, England

Received August 1973

SUMMARY The instrumentation associated with nuclear sciences has always taken advantage of new data-processing techniques. The early introduction of the modular concept and its continuous development led to the CAMAC Standard. The modular concept is described and the advantages of CAMAC are examined.

INTRODUCTION

A long accepted practice of electronic engineers has been to break down large measurement and control systems into small self-contained units for ease of specification, development, production, system fault-diagnosis and physical convenience. As in many other areas (building construction, furniture, etc.) the term 'modular' has been applied to equipment units whose physical size is, in one respect or another, a multiple of a basic dimension. A selection of these modular units can be combined in a standard framework for operational convenience, lower costs or just general tidiness. A classical example is the 19″ international standard instrument-panel and rack[1]. Rectangular panels, all of horizontal dimensions 19″ but of heights n_0U (where $U = 1.75$ inches), can be fitted across the front aperture of a standard rack. Chassis of given maximum horizontal and vertical dimensions can be fitted behind these front panels to contain the circuit components.

A more recent concept is to design units as unifunctional modules that are physically and operationally compatible and inter-changeable and can therefore be used as the basis of many systems[2] both simple and complex. This concept began to develop during the late '50s and early '60s, when transistors made it possible to have relatively small unifunctional modules which could be fitted into a framework within a 19″ front-panel chassis. With a wide selection of these unifunctional modules (e.g. amplifiers, filters, drivers, registers, etc.) to choose from, practically any measurement or control system could be assembled in these frameworks, and mounted in racks[3, 4].

PHYSICAL COMPATIBILITY

Such a framework (shelf, bin, crate or drawer) provides a volume whose height (H) is less than n_0U (to allow for horizontal tie-bars), whose width (W) is less than the clearance in the standard 19″ rack (to allow for vertical tie-bars) and whose depth (D) is limited only by what is physically reasonable. This volume (V) can be sub-divided into equal sub-volumes of $V/(n_h . n_d . n_w)$, where n_h, n_d, n_w are the dividing factors, and each sub-volume can be occupied by an electronic unit. However, for ease of access, etc., these sub-volumes are usually created by sub-division of the horizontal dimension (W) only, and the modules thereby have front aspects of horizontal width W/n_w, height n_0U and any depth (D). For any self-compatible set of modules, the values and tolerances of W, D, n_0 and n_w have to be fixed.

The design of every modular unit scheme defines the physical dimensions of the sub-units and the framework into which these units can be assembled to form systems. Schemes that have plug-in units also define the physical location and features of electrical mating parts, and the guidance and fixing of modules into the framework.

A comprehensive modular unit scheme specifies other characteristics in addition to physical dimensions. These additional levels of compatibility are listed below in decreasing order of occurrrence in existing modular schemes.

Power Supplies

This specification defines the voltage, ripple, impedance and other characteristics of the power supplies that a unit can expect to find available in a system. It includes the allocation of pins on mating connectors of plug-in units to specific power lines, and also their interconnection to satisfy specified losses, common-earth coupling, etc.

Signals and Connectors

The interconnections between functional modules that can be combined in various ways to make up different systems need more careful standardisation than interconnections between equipment specific to only one system. Signal outputs from one unit must drive inputs of another unit via an inter-connecting cable or network having defined characteristics, without the need for interposed buffers. Otherwise the flexibility of a modular system can be much reduced.

Data Transfer Characteristics

When digital information has to be transferred from one unit to another in an assembly of units, there must be defined procedures for doing this, if the highest degree of compatibility is to be achieved. These procedures can involve, for example, specific codes for addressing and commanding units, the allocation of significance to bit order, and the timing of transfer cycles.

Ergonomic Features

The front-panels of units are often an interface between the operator and the measurement/control system. They are fitted with control-knobs, switches, displays, lamps, meters, indicators, etc. Each such item needs to be labelled, to show its function, and positioned where it can be seen and used conveniently. This can be achieved by rules covering front-panel layout and by a glossary of terms and abbreviations. The glossary prevents the use of the same word on two different units to mean different things or different words on different units to mean the same.

ADVANTAGES OF MODULARITY

The degree to which a particular scheme can claim the following advantages depends on the levels of compatibility specified in the scheme.

- Modularity provides flexibility in system size and configuration.
- Interchangeability permits rapid replacement of faulty units and this in turn leads to short "downtimes".
- Compatibility of characteristics of units enables a rationalisation of documentation and test procedures giving low-cost diagnostics and maintenance.
- The use of the same types of units in different systems enables stocks of units and spares to be kept small, thus giving a high utilisation of capital investment. By concentrating the demand on fewer types it allows quality control on batch production of units.
- Existing systems can be expanded or up-dated at only marginal cost.
- New facilities in the range of units can be added quickly and for low development costs.
- Valuable and costly design effort need not be wasted on problems that are already solved by the scheme (chassis size, power supply, methods of data transfer, etc.).
- Possible solutions to a particular measurement or control problem can be evaluated rapidly by using a basic range of units.
- Technical and maintenance staff who are familiar with the scheme can be interchanged between projects.

DISADVANTAGES OF MODULARITY

A fully comprehensive modular scheme has also these disadvantages:

- The development of the compatibility rules for a scheme can be costly and prolonged.
- Extreme difficulty can be experienced in up-dating or modifying the compatibility rules, as technologies change or develop, without rendering earlier units obsolete.
- Units will contain features which, though relevant in the total applications context, may not be necessary for a specific application, thereby increasing cost and unreliability.
- Acceptance of a particular scheme involves commitment to that scheme thereafter.

CAMAC

The CAMAC specifications cover all important aspects of compatibility and bring the advantages of comprehensive modularity. The disadvantages also apply, but their effect has been made small either by the design principles of CAMAC or by its multinational acceptance, as the following examples show.

Although CAMAC has taken, so far, about seven years, and an estimated $5 M (equivalent) to develop, it is now a proven standard and can be used free of charge by anyone.

Commitment to CAMAC is not restrictive since equipment and expertise is available from many sources throughout the world. The CAMAC standard is not tied to a particular manufacturer of computers or peripherals, and is multinational in origin. The independence that CAMAC gives to a user is a tremendous benefit, far outweighing the disadvantages which normally arise from commitment to a standard.

Some features of CAMAC give redundancy in certain applications. For example, the CAMAC highway is capable of 24-bit parallel transmission, and appears somewhat excessive for an 8-bit parallel requirement. However, CAMAC does not specify that systems must use all 24 bits. A system employing modules and controllers with only an 8-bit capability can be totally CAMAC-compatible. The only redundancy would be edge-connector contacts and Dataway wiring in the crate, and Dataway connector pins on the module. The cost of this redundancy per station would be less than 2% of the cost of a typical CAMAC module. Clearly, the use of a 24-bit crate and a controller with 24-bit capability in a system employing 8-bit modules involves greater redundancy, but even this could be economically attractive if the controller is already available, compared with designing a specific controller for a single requirement.

Finally, design features of CAMAC such as the address, demand handling and data-width, allow advantage to be taken of new technologies, such as large-scale integration, and low-cost large-capacity storage. Therefore it should be possible, for some time to come, to accommodate within the CAMAC standard any evolution of electronic data-processing relevant to the real-time, on-line applications for which CAMAC provides a powerful multiplexing interface.

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2

THE CAMAC SERIAL HIGHWAY — A PREVIEW

by
R. C. M. Barnes
Atomic Energy Research Establishment, Harwell, England

SUMMARY Advance information is given on a new CAMAC serial highway, complementing the existing parallel Branch Highway (EUR 4600 e). This serial highway can be used, either alone or in conjunction with modems, over longer distances and in noisy environments. It can be connected to standard communications interfaces available on most computers.

INTRODUCTION

The CAMAC Serial Highway described in this paper is the result of work carried out jointly by the NIM-CAMAC Dataway Working Group (Chairman, F. A. Kirsten) and its Serial Subgroup (Chairman D. R. Machen), and the ESONE Dataway Working Group (Chairman, H. Klessmann) and its Serial Subgroup. This paper is published with the permission of the chairmen of the Working Groups.

The existing parallel Branch Highway (EUR 4600 e) has proved to be a successful basis for interconnections in compact multicrate systems. There are Branch Highway interfaces for many popular minicomputers, and this has done much to encourage widespread use of the highway. On the other hand, use of the Branch Highway in simple systems and with less popular computers has undoubtedly been hindered by the need to have such an interface. Branch Highway systems can work over distances of a few kilometres using balanced-signal extenders, but the cost and installation of 65-pair cable are limitations.

The Serial Highway primarily provides much simpler interconnections than the 65 signals of the parallel Branch. It allows multicrate systems to use readily-available communications facilities, and provides protection against transmission errors. However, each CAMAC operation involves transmitting a sequence of messages, and generally takes longer than operations on the parallel Branch. Thus it does not supersede the parallel Branch, but is complementary to it in applications where simple interconnections are of major importance.

The Serial Highway can be connected to a computer through an interface unit (serial driver) that organises some or all of the message sequence by hardware. However, the message format is such that the highway can also be connected through a simple adapter to low-cost communications interfaces that are available on most computers. In this case the message sequence is organised by software in the computer. The Serial Highway is thus useful as a simple means of connecting a computer to one or more CAMAC crates, even when these are not remote.

ORGANISATION

Each serial crate controller (SCC) and serial driver (SD) is connected to the highway through two D (Defined) ports for input and output, respectively.

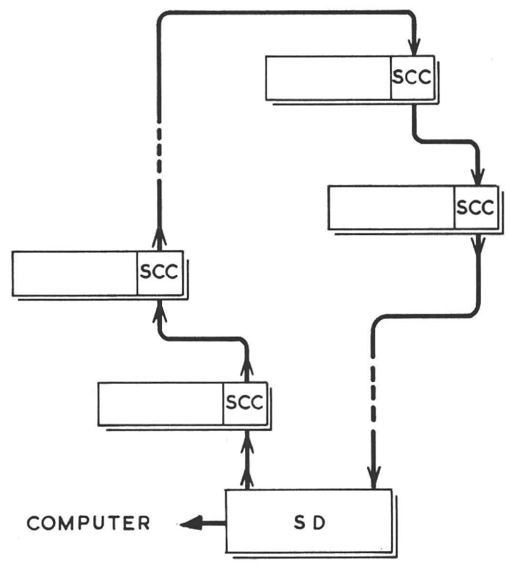

Fig. 1 Serial Highway: Unidirectional Open Loop
SCC = Serial Crate Controller
SD = Serial Driver

The crate controllers are connected in a chain, looped between the two ports of the serial driver (Fig. 1). The same unidirectional route is used for all messages. Each crate controller monitors all messages received at its input port, and retransmits at its output port all those that are not addressed to it. Thus, command messages are passed from the output port of SD through intervening crate controllers to the input port of the addressed SCC. Similarly, reply messages are passed from the output port of the addressed SCC through intervening crate controllers to the input port of SD. Demand messages may be generated at appropriate times by any SCC, and are also passed to the input port of SD.

All messages are structured as sequences of 8-bit bytes, consisting of six bits of information, one delimiter bit for message synchronisation, and one parity bit for error detection. Each message includes a SUM byte with a checksum of the information bits in the preceding bytes. The two-coordinate combination of parity and checksum is a powerful means of error detection. In the END byte of each message the delimiter bit forces all SCC's to await the beginning of a new message. Between messages the SD transmits WAIT bytes.

Each CAMAC operation involves a command message of 6 or 10 bytes (C, N, A, F, W1-4 if required, SUM and END), and a reply message of 7 or 3 bytes (C, STATUS, R1-4 if required, and ENDSUM).

The ports have provision for bit-serial or byte-serial mode. In bit-serial mode the 8 bits of a byte are transmitted serially, with a start bit and 1 or 2 stop bits making up a frame of 10 or 11 bits. There is a bit-rate clock signal at the ports, and each SCC derives a byte-rate clock from the framing bits. In byte-serial mode the 8 bits of each byte are transmitted in parallel, and there is a byte-rate clock signal at the ports.

In all other respects, such as message structure and signal standards, the two modes are identical.

INTERCONNECTIONS

The D ports on SCC have separate balanced current-mode circuits for information and clock. These can be connected directly to the next SCC in the chain over moderate distances, using dedicated twisted pair cables. Alternatively, any section of the highway may include communications terminals, such as modems to operate over longer distances and public telephone networks. Between modems the information and clock may be combined into one unidirectional channel. The Serial Highway loop may be folded back on itself in order to use duplex channels and modems (Fig. 2). There may

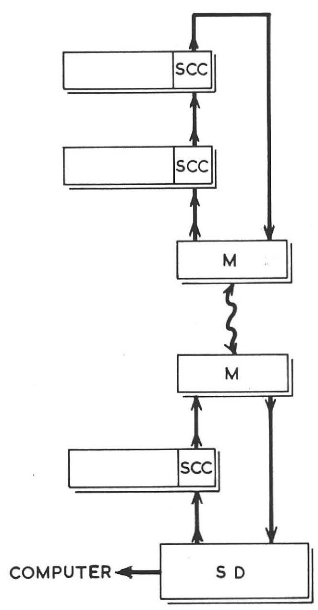

Fig. 2 Serial Highway: Duplex Route with Modems

SCC = Serial Crate Controller
SD = Serial Driver
M = Duplex Modem

be a mixture of various communications channels and direct connections, depending on the needs of different sections of the highway. However, the clock rate is determined by SD or the communications equipment, and must be uniform throughout the loop.

Other options are available to bypass individual crate controllers or parts of the loop, so that the remainder of the system can continue to operate when equipment is faulty or withdrawn from service. The bypass switching can be controlled remotely from SD.

DEMAND HANDLING

A crate controller whose demands have been enabled by SD responds to a Dataway LAM by generating a 3-byte demand message (C, GL, ENDSUM). The crate number indicates the source of the demand. In simple systems this may merely initiate a poll of LAM sources in the crate. The GL byte is derived from an SGL Encoder via a connector on the SCC, and its significance is a function of the Encoder or patching on the connector. For example, it could indicate the GL number of the highest-level demand in the crate.

The SCC interposes the 3-byte demand message between two messages in the incoming stream and then removes three WAIT bytes from the same, or some later, point in the stream. In the meantime, incoming messages are diverted through a 3-byte delay and the SCC cannot generate another demand.

There is a risk that demand messages may be corrupted and lost. Hence, SCC includes a timer to detect unserviced demands and initiate a high-level demand message.

PERFORMANCE

The time to implement a CAMAC operation depends on factors such as

- The clock rate. This can be 5MHZ for direct connections between the D ports, but is typically much less when using public telephone channels.
- The signal propagation time around the loop. This will usually be dominated by the delay of one clock period (one bit or one byte) in each SCC needed to allow the information signals to be sampled and reconstituted.
- The number of 3-byte demand delays that are temporarily present in the loop.

An efficient directly connected byte-serial system with few crates can implement a command in about 5 μs, similar to the parallel Branch. A directly connected bit-serial system with the maximum number of crates takes about 50 μs. A system operating over telephone speech circuits is much slower.

CONCLUSION

The CAMAC Serial Highway uses a sequence of serial byte-organised signals in place of the many parallel signals of the Branch Highway. It therefore has a complementary role where 65-pair cable cannot be installed, or where the CAMAC system can be controlled by a software-driven communications interface on the computer.

The Serial Highway is fully compatible with the basic CAMAC specification, EUR 4100e (1972), and can implement the full range of CAMAC operations. It is based on the same concepts as the Branch Highway, but has a 6-bit crate address, implements demand handling in a different way, and provides for error detection and recovery.

Workers on other serial systems [1,2], which are significantly different, have made valuable contributions to this work.

A detailed description of the serial system organisation is being prepared. This will include a recommended set of features for a fully interchangeable crate controller (Serial Crate Controller Type L). A formal specification of the serial system and SCC-L will be issued later.

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APPLICATION NOTES

A DATA ACQUISITION SYSTEM BASED ON CAMAC AND SUPPORTED BY BASIC AND FORTRAN

by

D.A. LePatourel*, R.R. Johnson*, D. Marquardt** and D. Gurd**

Physics Department* and TRIUMF**, University of British Columbia, Vancouver, Canada

Received 7th May 1973

SUMMARY A 12k minicomputer has been used with CAMAC and NIM equipment in an intermediate-energy nuclear scattering data acquisition system. The system is programmed in BASIC or FORTRAN, with sub-routines for input/output via CAMAC. The version with BASIC is most useful to experimenters, except where higher data rates require the use of FORTRAN.

INTRODUCTION

This paper describes the data acquisition system (DAS) developed for a 50 MeV π^+d differential cross section scattering experiment using a NOVA 1200 computer. An incident pion beam strikes a liquid deuterium target and scattered particles are detected in a stopping plastic scintillator. The pion trajectory is determined by spark chamber arrays. The data acquisition program was initially developed using the BASIC interpreter. This commonly known interactive language allowed the experimenters to edit and expand the DAS easily. When a final configuration was reached for production running, the system language was changed to FORTRAN to speed up the data logging.

SYSTEM DESCRIPTION

The system was built with the idea of incorporating an easy-to-use, flexible programming language with the CAMAC specification. High level languages familiar to most scientists were used. The system speed is limited by the CAMAC cycle time, by details of the operating system, and, most important, by the program language speed. The two distinct portions of an experiment, debugging and full scale data acquisition, have different program requirements. Initially, ease of program editing is the most important consideration. Later, speed of event handling replaces it. These changes have been met by using two different programming languages, BASIC and FORTRAN.

System Hardware Interfacing

Two system interfaces are required, one to translate a fast NIM coincidence signal into a computer interrupt to signal an event, the other the standard CAMAC interface. In principle, the standard CAMAC interface with an interrupt feature is capable of event interrupting[1] and has been used in other applications.[2]

The NOVA-NIM Interrupt Unit is daisy-chained onto the NOVA I/O cable before the Branch Highway Driver, BHD. The "event definition" pulse is input to it, causing this device to request servicing. The service routine initiates transfer of experimental data from CAMAC to the NOVA. During the transfer, the interrupt unit outputs a NIM pulse, used to inhibit NIM unit responses to new events.

Branch Highway Driver

The Master Branch Highway Driver is designed to interface a NOVA computer to a CAMAC system. It can drive up to seven crates directly. It can also drive three Slave BHD's which in turn drive seven crates, bringing twenty-eight CAMAC crates under the control of the Master BHD.[1] This is a non-standard CAMAC feature and necessitates a Branch Highway code in each command as well as the standard CNA.

To initiate a command to the CAMAC system, the three sixteen-bit buffers of the BHD must be loaded from core. A command requires specification of a three-bit crate number C (1 to 7), a five-bit station number N (1 to 24) and a four-bit sub-address A. A five-bit function code F is also necessary. A four-bit branch code must be specified if the Master/Slave configuration is used.

With the buffers loaded in the above manner a start pulse from the computer will initiate a CAMAC cycle. An error flag is returned indicating the success or failure of the CAMAC cycle.

BASIC

BASIC was the programming language chosen for use during system installation and commissioning. BASIC is interactive. Programs can be halted, edited, and restarted from a teletype at any time during execution without otherwise affecting them. Since BASIC is an interpretive system, storing the teletype code program line-by-line, it is slow. Assembler language subroutines for CAMAC operations were added to the BASIC system using a special CALL feature of DATAGEN BASIC.*

* DATAGEN of CANADA, Ltd. Hull, Quebec. Copywrite 1970.

CALL 1, (C), (N), (A), (F), D, E executes a CAMAC read operation. The user enters decimal numbers for C, N, A, and F to read or to read-and-clear a module. Data is returned as variable D. A zero is returned in E for a successful CAMAC operation or a CAMAC error code is returned in E for an unsuccessful operation. CALL 2, (C), (N), (A), (F), (D), E is used analogously to write data into a module. Either operation takes about 10 msec although only 30 μsec of that is the actual CAMAC operation.

Single CAMAC read or write instructions are used to check the operation of modules. Even during commissioning, however, the execution times of single CAMAC instructions have been excessive. Sequences of CAMAC instructions can be defined by CALL 4711, J, I, C, N, A, F, D, where J is one of five allowed sequences and I is one of 10 allowed sequence elements. CNAF bear the usual CAMAC significance. CALL 3, J, Z(J, 1), E allows the execution of the CAMAC sequence J with the resulting data returned to row J of array Z. A zero returned for E indicates a successful sequence execution while other E values indicate errors during the sequence execution. The execution speed is much shorter (about 1 msec per CAMAC instruction) than single CAMAC instructions, since an assembled program is used when the sequence is being executed. The time difference between this and the CAMAC operation time (40 μsec) is due to data conversion to the BASIC floating point format.

BASIC responds only to teletype interrupts. CALL 4 is used for program access when event interrupts are expected. It takes program control from BASIC and puts the system into a loop awaiting the arrival of an event interrupt. Program control is returned to BASIC when an event interrupt occurs. CAMAC sequence calls are then executed to gather data associated with that event.

One additional feature is associated with CALL 4. Data acquisition may be stopped at a known point in the program. The CALL 4 loop checks front panel switches expecting to find only Switch 14 up. If the user puts it down, a crate inhibit command is sent to CAMAC, suspending CAMAC operation until the switch is again returned to an up position.

A magnetic tape handler was incorporated into a separate subroutine, CALL 9. It is used primarily to write raw data from the Z array onto tape for later analysis, but is capable of any tape handling operation. Free format for recorded data is used. Writing onto tape considerably increases the time needed to analyze an event. From start to completion, a tape write operation requires about 50 msec. Consequently, data from 12 events are stored in the computer before the data is logged as a single record on magnetic tape. This reduces the net writing time to about 5 msec per event.

To speed up event analysis, assembler subroutines (CALL 21 and CALL 22) were developed to interpret the hodoscope reading and the spark chamber data for each event. CALL 22 is a bit-examining routine to see if just one hodoscope element, or possibly two adjacent elements, fired. Any other result is interpreted as an error. Either a multiple passage of particles through the hodoscope or a failure of the equipment is possible. CALL 21 checks proper operation of all 8 spark planes, including correct fiducial marks and multiple sparking.

The execution speed achieved by assembler-coding these two program segments is condiderable. CALL 21 requires 130_8 instructions and executes in about 100 μsec. It is equivalent to ten lines of BASIC, which would execute in 100 msec. CALL 22 requires 53_8 instructions and executes in about 50 μsec. It is equivalent to about 25 lines of BASIC, executing in 250 msec. The speed increase is over three orders of magnitude.

To date, the most rapid acquisition program used with the BASIC/CAMAC system accepts data from CAMAC with sequence-reads, performs CALL 21 and CALL 22 operations, and records the data on magnetic tape, requiring about 200 msec per event. This is about the speed limit on this form of BASIC/CAMAC data acquisition. Appendix A contains a simple BASIC data acquisition program.

FORTRAN

Several advantages are gained by a change to FORTRAN as the DAS language. Primarily, the increased speed of event handling justifies the change. FORTRAN-CAMAC sequence-reads offer a time saving of up to an order of magnitude over BASIC/CAMAC sequence-reads. Since single precision (16 bit) integer format can be specified for all variables in the main FORTRAN program, no time is wasted in conversion between fixed and floating formats. An added advantage is that magnetic tapes written with free-formatted binary integers are easy to read, so that translation software for data analysis is minimal.

Assembler language subroutines are simple to incorporate since the DATAGEN FORTRAN compiler accepts machine language instructions as part of a FORTRAN program. FORTRAN is not interactive, but this feature is hardly missed after a system has reached its final configuration.

FORTRAN Subroutines

Subroutines written for handling CAMAC and tape units are quite similar to their BASIC counterparts. Thus, CALL CYCLE (C, N, A, F, D, (1), $n) does a single CAMAC operation, returning the low order sixteen bits to D(2) and the high order eight bits to D(1). A hardware error causes a return to line n in the main program.

Similarly, a sequence operation is effected with CALL EXEC (X(1, I), Y, $n). X is a $3 \times Y$ integer array. CNA is encoded into X(1, I) as the Ith command in the sequence. F and the eight high order data bits are in X(2, I), and the sixteen low order bits are returned to X(3, 1); Y is the number of commands in the sequence and is limited only by available core.

The routine to build a sequence is similar to CALL 4711 in BASIC. An example of a FORTRAN sequence construction is presented in Appendix B. The hodoscope and magnetic tape routines are unchanged, but spark chambers are handled with just a FORTRAN subroutine. A brief data acquisition system program in FORTRAN performing the same analysis as the BASIC program in Appendix B takes no more than 50 msec per event, with most of that time used for the tape unit to write the data record. The obvious improvement to this, one incorporated in the BASIC program as well, is multiple event logging. Data for 20 events is accumulated in a large array, then written onto tape so that the time required to record each event averages less than 2.5 msec.

CONCLUSION

The approach adopted towards DAS development has been reasonably successful. A BASIS-CAMAC system certainly offers experimenters a simple way in which to reach a final configuration without much reprogramming. The system fails to be satisfactory, however, when event rates rise much above five per sec. A change to FORTRAN is the next logical step to preserve the flexibility and ease of use offered by a high level language, and increases the DAS speed. Since the equivalent FORTRAN data logging program takes only 2.5 msec (200 per second), the FORTRAN DAS is not computer limited. Additional calculation can be done during the dead time of the nuclear electronics.

It has been demonstrated that a CAMAC system with a high level controlling language has wide application once the initial system has been established.

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APPENDIX A

A Brief Data Acquisition Program in BASIC

As a specific example of a data acquisition program in BASIC, the following is included, with a brief description of its operation:

```
1000 CALL 4
1020 LET Z(0,10) = Z(0,10)+1
1040 CALL 3,1,Z(1,1),E1
1041 CALL 3,2,Z(2,1),E2
1042 CALL 3,3,Z(3,1),E0
1043 CALL 3,4,Z(4,1),E3
1060 CALL 9,50,1,Z(0,9),W1,1
1100 CALL 22,Z(2,10),H1,W4
1101 LET H(H1) = H(H1)+1
1102 IF W4 < 2GOTO 1120
1103 LET E(8) = E(8)+1
1104 GOTO 1000
1120 LET W1 = 0
1121 FOR I = 0 TO 7
1123 CALL 21,W3,F(I),I+1,L(I),U(I),W4
1124 IF W4 > 0 GOTO 1128
1125 LET S(I,W3) = S(I,W3)+1
1127 LET W1 = 1
1128 NEXT I
1129 LET F8 = F8+W1
1130 IF W1 = 1 GOTO 1000
1140 LET S2 = Z(2,8)/25+25
1141 IF S2 > 0 GOTO 1143
1142 LET S2 = 0
1143 IF S2 < 100 GOTO 1145
1144 LET S2 = 100
1145 LET Q(0,S2) = Q(0,S2)+1
1150 GOTO 1000
```

Line 1000 sets the system in a condition to accept an event.

Control is returned to BASIC when the event interrupt occurs, and the next four lines (1041 to 1043) are four CAMAC sequence-reads of ten commands each. These read all the data associated with a single event and store it in a 5×10 array Z.

APPENDIX B

An example of a ten element CAMAC sequence using DGC FORTRAN is included to demonstrate the use of some of the FORTRAN subroutines.

```
INTEGER D(2)
INTEGER X(3,10)
DO 20 I=1,10
ACCEPT C,N,A,F,D (1),D(2)
CALL SEQNC (X(1,1),C,N,A,F,D(1))
```

Each time the program encounters the ACCEPT statement, it pauses while the user enters C, N, A, F, and data necessary for any write commands. Data can be up to 24 bits with the low order 16 bits in D(2) and the high order 8 bits in D(1).

The following segment awaits the arrival of an event pulse (i.e. an interrupt from device 40) and then executes the entire sequence.

```
40  CALL IWAIT (DEV)
    IF (DEV.EQ.40) GOTO 50
45  TYPE "ERROR"
    PAUSE
50  CALL EXEC (X(L,L),L),$45)
    GOTO 40
```

After the sequence execution, data from the Ith entry is in X(2, I) and X(3, 1) (high and low order respectively). An error in BTB or Q response causes transfer to line 45.

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LABORATORY REVIEWS

CAMAC APPLICATIONS IN THE CENTRAL ELECTRICITY RESEARCH LABORATORIES

by

E. G. Kingham and R. E. Martin

Central Electricity Research Laboratories, Leatherhead, England

Received 7th April 1973

SUMMARY The paper reviews various applications of CAMAC in a multi-discipline research laboratory. Two autonomous systems are used for data logging and supervision. Other autonomous systems control and collect data from an electron-beam analyser and X-ray diffractometer. A computer-based system is used for data acquisition and processing.

INTRODUCTION

The Central Electricity Research Laboratories (CERL) is a multi-discipline organisation employing some 800 staff of whom some 300 are professional scientists and engineers. It is the largest of the three major laboratories of the Central Electricity Generating Board. The work of the laboratories covers Electrical Engineering, Physics, Chemistry and Biology, Engineering Sciences, Materials, and Control & Communications. Thus a very wide range of requirements exists for the instrumentation of experiments and for the acquisition of analog and digital data. In the past CERL used proprietary instrumentation systems, but in 1970 a decision was made to use CAMAC wherever possible. The development of a low level multiplexer for use with CAMAC was initiated. This multiplexer is now available as Nuclear Enterprises Type CE600 and CE601. It includes an option to provide programmable cold junction compensation for thermocouples.

The availability of such items led to a considerable use of CAMAC within CERL. The benefits of speedy reconfiguration, ease of maintenance, reliability, recoverability and the use of a standardised but non-proprietary system have been amply realised. The earlier CAMAC systems were bought complete, but all later systems have been engineered within CERL, using commercial CAMAC items.

CAMAC AT CERL

At present there are seven CAMAC systems in regular use based on CAMAC. The value of the CAMAC parts of these systems, together with spares, is about £50,000.

In the following sections the properties of some of these systems are outlined briefly in order to show the wide variety of applications.

CAMAC SUPERVISORY AND LOGGING SYSTEM

This was originally planned as a 96-channel logging and supervisory alarm system. It is used for temperature monitoring and recording, as well as automatic weighing of heated corrosion specimens. It was later extended to accommodate a further 32 channels on the same test facility. It was yet again adapted to serve a second experimental rig at a distance of some 150m which required a further 16 channels and a second teletype. The input channels of these systems comprise a mixture of thermocouple emf's and millivolt-level signals from other transducers, scanned by the multiplexers mentioned above. The multiplexers are often located near the transducers to reduce cabling requirements. The system monitors data for alarm conditions, and also prints out a log of the data at pre-determined intervals.

Fig. 1 illustrates the block diagram of this system in which the analog signals (in the range 0-110mV) are transmitted from various locations to a common DVM. Because of the high mains electrical interference levels, and the need to measure low level analog signals to $\pm 10\,\mu V$, it is essential to use double

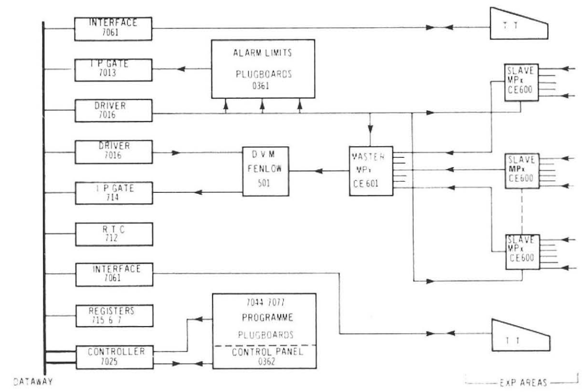

Fig. 1 CAMAC Data Logger

pole multiplexer switches and a switched "guard", together with an integrating digital voltmeter. This enables series and common mode interference in the overall system to be rejected. The sampling rate has to be more than one sample per two mains periods, namely 40mS with a 50Hz supply. In this particular system the sampling rate is only 1 per second. The system is controlled by a Dataway controller whose programs are set up on pin-boards.

ELECTRON BEAM ANALYSER

This system provides not only for data acquisition from three digital inputs (obtained from pulse counters and from a digitised measurement of electron beam current) but for control of the sample position by stepping motor. The sample position is initially input from a manually prepared paper tape, and this tape is regenerated in an updated form for further sample positions during the course of the analysis. The data is recorded on tape and subsequently examined off-line. The system employs a Dataway controller with pin-board program stores. Fig. 2 illustrates the system.

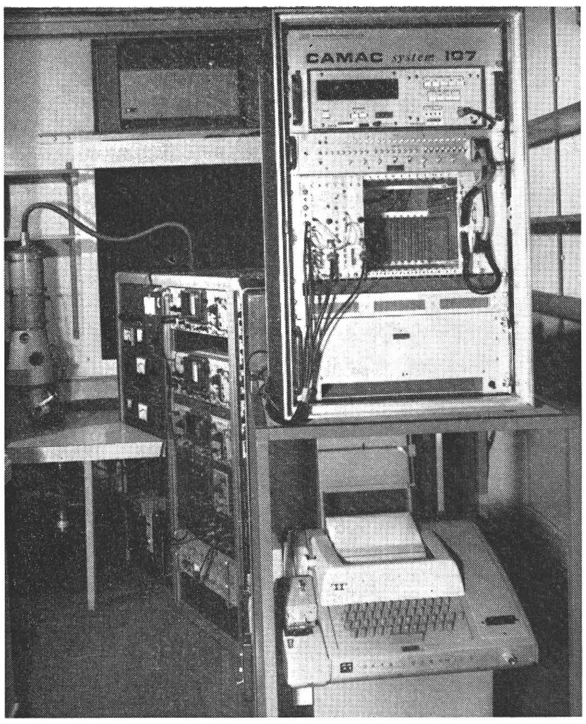

Fig. 2 Electron Beam Analyser

DIFFRACTOMETER CONTROL SYSTEM

An X-ray diffractometer requires measurement of the X-ray intensity at fixed angular positions. The CAMAC system[1] controls the position of the diffractometer table either continuously or in discrete steps. Peak seeking facilities are incorporated so that the time required for an analysis is minimised and the equipment can very largely be left running unattended. The system is controlled from a Dataway controller with pin-board program stores.

GENERAL PURPOSE LOGGER

A version of the supervisory and logging system described above has been constructed as a transportable logging facility capable of scanning up to at least 256 analog data points. The equipment provides output to a teletypewriter or to a VDU.

CENTRAL DATA ACQUISITION AND PROCESSING SYSTEM-CDAPS

The system consists of a Computer Technology (CTL) Modular One computer interfaced via CAMAC modules to the rigs, which may be up to several hundred metres distant. The individual data points are selected under computer control by multiplexers located near the rigs. The present hardware can accommodate some 750 analog inputs distributed among many users.

The analog data, in the range 0-100mV, are converted to digital signals centrally at 10 points per second, and transferred to the computer for processing. The results are returned to the user on his own CAMAC-driven teletype or made available in a form suitable for further off-line processing.

A suite of standard "logging" programs provides various commonly required options such as alarm limits, conversion to engineering units, print-out, etc. Users can also insert high level language programs (at present in "CORAL") to carry out more advanced calculations on their own data in real time. The CDAPS system, within the limitations imposed by available computer storage (at present 24k of core store), serves a number of users effectively simultaneously, in a multi-programming time sharing manner.

The coupling between the MODULAR ONE computer and CAMAC was initially by means of serial teletypewriter interface modules speeded up to operate at 1000 characters per second. At a later stage a coupler between MODULAR ONE and CAMAC became available using parallel communication, and this coupler (CTL Type 1.751) has significantly improved the overall speed of the system. However, future applications will include data acquisition at higher speeds (e.g. 5-10 kHz). This would be greatly facilitated by the use of direct memory access facilities which are not available in the present coupler. The CDAPS system will be further described in a future issue.

SOFTWARE

The preparation of software is at present tedious and necessitates a specialist knowledge of CAMAC. This, together with the need to adapt programs frequently during the progress of research work, can inhibit the more general use of CAMAC. The move towards a CAMAC language is therefore welcome and should help the speedy development of programs.

SUITABILITY OF CAMAC

CAMAC has proved its value in adaptability and ability to upgrade systems as the research requirement changes. The reliability of CAMAC modules appears to be at least comparable with that of proprietary digital equipment. Such failures as have occurred have often been traced to interconnectors and pin-board storage. The multiplicity of front-panel connections is unsatisfactory and tends to detract from the industrial suitability of the system. It is considered that there is room for an industrial version of CAMAC modules in which more attention would be paid to the reduction of panel connections and to the introduction of rigorous environmental specifications particularly with respect to temperature. The successful implementation of CAMAC within large industries for industrial purposes, for example for process and telecontrol, would be helped by more attention to the above points. Nevertheless, CAMAC has proved to be very advantageous within CERL and its use can be expected to grow.

ACKNOWLEDGEMENTS

The work was carried out at the Central Electricity Research Laboratories and the paper is published by permission of the Central Electricity Generating Board.

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1. Burley, A.C., Prior, G.M., Adams, A.M., Kingham, E.G., A CAMAC System for the Control of a Diffractometer. *CAMAC Bulletin*, No. 3 (1972) p. 12.
2. Proposal for a CAMAC Language. *CAMAC Bulletin*, No. 5 (1972) supplement.

DEVELOPMENT ACTIVITIES

CAMAC BRANCH DRIVER FOR LABEN COMPUTERS

1

by

L. Stanchi

Euratom Joint Research Center, Ispra, Italy

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SUMMARY A branch driver for use with Laben 70 and 701 computers is described. It contains features for fast handling of special LAM's, for address scans over an unknown number of registers, and for direct transfer of data between modules.

INTRODUCTION

CAMAC is an efficient method of interfacing computers to controlled devices. In Ispra we needed to use existing Laben computers with CAMAC systems, so we developed a dedicated branch driver in collaboration with the firm Laben. The result is a versatile branch driver, which is equipped to perform all the operations required by specification EUR4600 and some additional operations which are peculiar to this branch driver. It can handle data with 24 or 16 bits and contains registers for memorizing them before transferring. In addition there are 32-bit registers for storing commands and for reading the status of the branch driver.

It can operate under program control, program interrupt, or direct memory access (DMA). An interface that differs only in some special respects from the standard Laben interfaces is directly inserted into the computer, and completes the connection between computer and the branch driver. If a multibranch system has to be implemented, more than one branch driver is needed, each one with its own interface. Up to eight interfaces can be allocated in the standard cabinet.

SPECIAL LAM FEATURES

A very special feature of this branch driver is the fast handling of some LAMs. The normal LAM handling based on the BD signal and graded-L operation is not described exhaustively here, but special attention is given to two means of saving time when fast data acquisition is of primary importance.

Operations on three special LAMs. The branch driver has three separate inputs directly wired to LAM sources. As the Laben computer normally allocates 4 memory locations to each peripheral the modified interface occupies two peripheral numbers in order to have 8 memory locations which can be associated with the external device operating in program interrupt or in DMA. The eight locations are used in order of increasing priority as follows: three memory cells for data, one for BD, three for special LAMs L_1, L_2, L_3, and one for alarms. The three cells for data contain the input/output instruction in the first and, if required, the word counter and start address counter in the others. The branch demand signal has higher priority than the data but cannot interrupt a single transfer. The special LAMs are ranked according to priority and are serviced directly without requesting the LAM pattern. The highest priority is reserved for alarms, such as word counter overflow in succesful operation or some abnormal occurrences such as instrument not ready or $X = 0$, or $Q = 0$ when a 1 is expected, and so on.

Use of an Interrupt Vector Generator. When the special vector generator module is used the operation of the interface card is changed by substituting one patch connection. In this case the interface responds to 10_8 peripheral numbers and has the ability to access 32 memory cells of the computer directly. The first three cells are always assigned to data and the last to the high priority alarms. The other 28 cells are assigned with ranked priority to the BD signal and 27 special LAMs ordered by the Interrupt Vector Generator module.

ADDRESS SCAN WHEN THE LENGTH IS NOT KNOWN A PRIORI

This special feature results from the need to design a system with a large number of registers for memorizing a burst of neutrons at a speed unacceptable to the computer. This requires a buffer memory with sufficient registers to ensure that it is rarely overfilled. Hence, in normal operation many of the registers are empty and only a few have to be read. With the special means of handling the address scan mode (conforming fully to EUR 4100) we can choose by software between the normal operation with known length of block (word counter) and the use of a comparator for determining the end of block. In this second type of operation each register has a flag which controls the Q response. The registers are filled with incoming data in the order A0-A15, and only those that have been filled will respond with $Q = 1$ during the reading scan, so that station number N is incremented at the first empty register. A five bit comparator loaded by software recognizes the last module in the scan. The first empty register in this module will stop the scan. A crate number can be assigned to the last address by a patchable gate.

CONCLUSION

The details are not reported here because they are more or less conventional and can be found in any branch driver which is equipped to transfer a bidirectional flow of data having 24 bits in the CAMAC system and 16 bits in the computer word. Attention is directed to the "Executive" mode which permits this branch driver to exchange information between controlled modules without loading the computer memory. If a special command is addressed by the computer to the branch driver it stores in its register the data coming from one module and overwrites the data into another module.

A 32-bit register is used for storing commands from the computer, which are sent always in double word format. The first word contains an 11-bit control field and the F function. The second contains the full address CNA. All the operations listed in EUR 4600 are possible and the branch driver is normally used with Type A1 crate controllers. Some special features for LAM handling based on the BD signal can be preset by the program. More details can be found in the references. Complete schematics are in Ref. 2, but the text is in Italian.

The work of Messrs M. Bernede, G. De Grandi and J. Kalisz (on temporary leave from the center of Swierk, Poland) is greatly acknowledged. Collaboration with Messrs P. Bettini and A. Neglia of Laben led to fruitful results.

1. Bernede, M., *et al.*, CAMAC Branch Driver: A Particular Solution. *Nucl. Instrum. Methods*, to be published.
2. De Grandi, G., Thesis, Polytechnic of Milan.

NEWS

CAMAC SESSIONS AT 1973 NUCLEAR SCIENCE SYMPOSIUM NOV 14-16, 1973, SHERATON-PALACE HOTEL, SAN FRANCISCO, CALIFORNIA

Following earlier precedents, this year's symposium had two special sessions devoted to CAMAC papers and, reflecting the European-American cooperation on CAMAC, one session was in the French Parlour and the other in the California Room at the Sheraton Palace Hotel, San Francisco, November 14/16.

A more pertinent demonstration of this cooperation was that 6 of the 15 papers were from European sources. The panel discussion centred on the CAMAC highways as a means of interconnecting crates and computers. A detailed report will be available in *CAMAC Bulletin* No. 9.

Titles and authors of presented papers are given below:

CAMAC as a Computer Peripheral Interface System — A.C. Peatfield, K. Spurling and B. Zacharov, Daresbury Nuclear Physics Laboratory, England.

Highways for CAMAC Systems: A Brief Introduction — L. Costrell, Nat'l Bureau of Stds.

The CAMAC Serial System for Long Line, Multicrate Applications — D.R. Machen, Los Alamos Scientific Laboratory.

Operational Aspects of a Serial CAMAC System — E.J. Barsotti, H.C. Lau and J.R. Simonton, National Accelerator Laboratory.

CAMAC Serial Loop with Intelligent Crate Controller — H. Halling, KFA, Julich, Germany.

An Optically-Coupled Serial CAMAC System — D.R. Heywood and B. Ozzard, TRIUMF, University of British Columbia.

CAMAC Applications in Nuclear Medicine at Vanderbilt: Present Status and Future Plans — A.B. Brill, J. Parker, J. Erickson, R. Price and J. Patton, Vanderbilt University.

CAMAC for Data and Computer Communications — B. Zacharov, Daresbury Nuclear Physics Laboratory, England.

An Introduction to CAMAC Software — I.N. Hooton, AERE, Harwell, England.

CAMAC Stand-Alone Control System (CAMSAC) — R.G. Martin, National Accelerator Labaratory.

A CAMAC System for the Automatic Testing of Photomultiplier Tubes — A.C. Burley and H.A.W. Tothill, Nuclear Entreprises, Ltd., Beenham, Reading, England.

Proportional Wire Chamber Readout System at Daresbury Nuclear Physics Laboratory — J.C. Beach, A.C. Peatfield and A.J. White, Daresbury Nuclear Physics Laboratory, England.

Fast Readout and Geometrical Reconstruction System for Proportional Wire Chambers — S. Dhawan, Yale University.

Digital Monitoring System for NAL Secondary Beam Line Instrumentation — R.G. Martin, National Accelerator Laboratory.

A CAMAC Single Crate Controller for Synchronized DMA Transfers and an ADC Interface Module — R.A. LaSalle, Florida State University.

Title Only: CAMAC Scanning DVM System — R.G. Martin and A.E. Brenner, National Accelerator Laboratory.

2

DEVELOPMENTS IN HARDWARE AND SOFTWARE FOR THE 7025 PROGRAMMED DATAWAY CONTROLLER

by
L. D. Ward and R. C. M. Barnes
Atomic Energy Research Establishment, Harwell, England
Received June 1973

SUMMARY Many successful CAMAC systems use the Harwell/Nuclear Enterprises 7025 Programmed Dataway Controller. The programs have mostly been written in machine code and held in 256-word read-only stores. New developments described in this paper provide assembly-level programming facilities and a 2730-word read-write store for programs and data.

INTRODUCTION

The programmed Dataway Controller Type 7025[1], designed by AERE Harwell and marketed by Nuclear Enterprises, includes many of the features normally found in a mini-computer. It executes a program of instructions and CAMAC commands read from an associated store, and can perform arithmetic and control operations on data. The full range of CAMAC operations can be performed on modules in the same crate as the controller, and in up to three additional crates.

Typical applications for this controller are in self-organising CAMAC systems, generally not associated with a computer, but sometimes acting as an intelligent satellite to a computer. There are more than 100 such systems. Papers in *CAMAC Bulletin* have described systems for data logging, control of laboratory instruments, airborne data recording, and as a multiplexer for inter-computer data links.

Many characteristics of the controller give it an advantage over the conventional arrangement of a separate 12- or 16-bit computer interfaced to a CAMAC controller. For example, features such as the 24-bit word-length, and single instructions to control a CAMAC operation and conditional skip on Q, are among those recommended in a recent paper by Cohn[2] on CAMAC-oriented processors.

The powerful 24-bit instructions (which can include 16-bit literal data) allow surprisingly complex programs to be written within the limit of 256 words set by the instruction counter. Many systems have been installed with read-only diode-matrix stores for program, and with active registers in modules for variable data and sub-routine return addresses. More recently, specialised 256-word read-write stores have become available, with direct addressing for instruction-fetch but indirect addressing through an address register for data transfers via the Dataway (requiring two instructions in general).

This paper describes a further development by AERE Harwell, extending the store capacity for program and data to 64 kilobits, giving 2730_{10} 24-bit words, all directly addressed by the program.

Short programs for the 7025 controller have usually been written directly in 'machine code'. This requires a detailed knowledge of the field-structure of the 24-bit instructions, and the use of absolute addresses for jump instructions and CAMAC registers. For larger programs it is clearly desirable to work in an assembly-level language, allowing mnemonic instruction codes, symbolic variables and labels, and isolation of the user from the details of instruction-word formats.

One such assembly language, CONCO[3], is used with an assembler which runs in a larger computer (PDP-10). This has been used to develop programs for plugboard-store systems, and the print-out from the assembler therefore includes a plugboard layout diagram.

The PROCOL programmed controller language described in this paper has been implemented with an assembler that runs in a CAMAC system consisting of the 7025 controller and 64-kilobit store.

THE PROGRAMMED DATAWAY CONTROLLER

The 7025 Programmed Dataway Controller is a triple-width plug-in unit. It is interfaced to the Dataway at the control station and a normal station, to the program store and control panel via front-panel connectors, and to any Harwell 7000 Series intercrate highway drivers via a rear-mounted Control Highway connector. The rack-mounted control panel (Type 0362) provides the usual mini-computer facilities for examining and loading the contents of the main registers, for starting and stopping the program, etc.

The instruction set of the controller includes Dataway operations (with transfers to or from the 24-bit accumulator register, and simultaneous testing of the Q response), arithmetic operations on the contents of the accumulator, and control operations such as Skip and Jump. For details see Appendix I of Reference 1 or 4.

THE 64-KILOBIT STORE

This development consists of a CAMAC plug-in unit (Store Interface Type 7067-2) and an Ampex core store unit (Fig. 1). The Store Interface is a triple-width unit, with access to the Dataway at a normal station and to the core store and controller through front-panel connectors. The core store is mounted behind the control panel in a Housing Unit (Type 0719) which provides forced air-cooling.

In order to reduce system costs the core store has an 8 K by 8-bit configuration, but the Store Interface automatically organises three store-cycles per 24-bit word. The resulting 2730 24-bit locations are directly addressable for both instruction and data storage.

The Store Interface extends the instruction set of the controller to include memory-reference instructions[4] that address any of the 2730 store locations, and are implemented partly in the controller and partly in the interface. These instructions provide for data transfers to and from the controllers' accumulator, (Store, Load, Add, Subtract, and Complement-Accumulator-and-add), for incrementing the

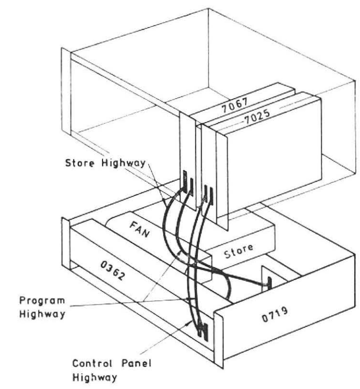

Fig. 1 Layout of 7025 Controller with 64-Kilobit Store, showing Store Interface 7067, Control Panel 0362, and Store Housing 0719.

contents of any location (Increment-Skip-if-Zero, Increment-Skip-if-Non-Zero) and for jumping to an instruction at any location (Jump, Clear-Accumulator-and-Jump, Jump-to-subroutine). The memory-reference instructions can have multiple levels of indirect addressing and auto-indexing of the indirect address.

Typical instruction cycle times are 33 μsec for store data transfers and 14 μsec for CAMAC Dataway operations.

SOFTWARE

The assembly language PROCOL has been developed for use with 7025/7067 CAMAC systems. The minimum software package consists of the PROCOL Assembler to translate source code into binary, and a Binary Loader to load the resulting object tape ready for execution. Debug and Binary Punch routines are available for program testing and development, and a line-by-line Text Editor for source-tape correction.

PROCOL provides the programmer with the usual advantages of an assembly language, including mnemonics for instruction codes (and CAMAC command parameters), labels assigned to instructions or data, the use of signed decimal or octal data and the introduction of formats and comments to assist in the layout and understanding of the program. The assembler executes a first pass of the source tape for syntax checking and label allocation, and a second pass for the output of binary tape. An optional third pass gives a full program listing.

The PROCOL assembler runs on the 7025 Programmed Dataway Controller with core store, and uses the instruction set as augmented by the 7067 Store Interface. It can assemble programs written in the augmented instruction set or the original instruction set of the 7025 controller. The software package including the assembler can therefore be used to develop programs for systems with read-only stores or 256-word read-write stores.

APPLICATIONS FOR THE 7025 CONTROLLER WITH 64-KILOBIT STORE

The combination of the 7025 Controller with the 64-kilobit core store finds typical applications in systems that are predominantly concerned with CAMAC input/output, but involve immediate access to a volume of data.

One example is in data logging systems with many channels, each with associated parameters such as previous values, alarm and warning levels, and status related to the scanning sequence or alarm condition. Systems have been designed with 1000 channels, and with data processing facilities such as conversion from measured values to user-oriented units. A noteworthy feature of these systems is the software control of scanning sequences, based on a stored table of parameters. Separate selections of individual channels and sampling rates can be made for data-logging and alarm scans.

Another application is as a CAMAC-based multichannel analyser of great versatility (Fig. 2). The analogue-to-digital converter, display, operating controls, and data-output peripherals are all interfaced through CAMAC modules. The core store

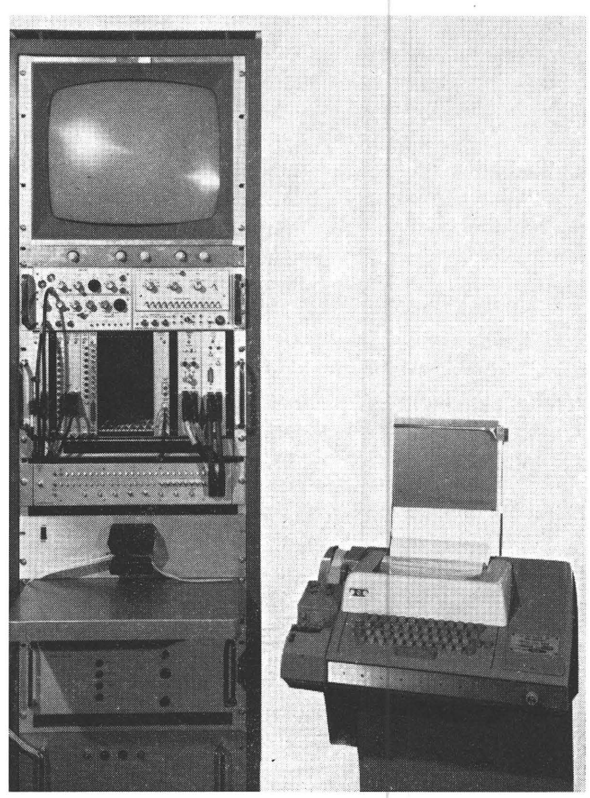

Fig. 2 A Multi-Channel Analyser System Using the 7025 Controller with 64-Kilobit Store

holds the current values for all channels (e.g. 1024 channels) and the programs for accumulating, displaying, processing and recording the data. Apart from any alternative modes of operation that are included in the program, the system can be converted rapidly to a different mode of operation (not necessarily related to conventional multi-channel analysis) by reading in a previously-assembled program.

The important features of the system are therefore the wide-range of peripherals that are available, the ability to change the data-handling process, and the ability to create new facilities by program development using the PROCOL software package.

CONCLUSION

The hardware and software developments described in this paper convert the well-tried 7025 Programmed Dataway Controller into a mini-computer whose I/0 bus is the Dataway, and whose peripherals and on-line connections are interfaced through CAMAC modules. This mini-computer within CAMAC is competitive with typical 12- or 16-bit computers external to CAMAC for systems where the emphasis is on input/output rather than arithmetic power or large store capacity. In such systems the direct 24-bit access to the Dataway, and the powerful 24-bit instruction, compensate for the apparently slow cycle time.

ACKNOWLEDGEMENTS

The authors are indebted to their past and present colleagues in Electronics and Applied Physics Division at AERE, in particular Mr. J. M. Richards who initiated this work and Mr. F. H. Hale who designed the multichannel analyser system.

REFERENCES

1. Ward L.D., Mitchell G.S.L., and Richards J.M., A Programmed Controller in the CAMAC System. AERE Harwell, England. Report AERE-R6334 (1970).
2. Cohn C.E., Considerations in the Design of CAMAC-Oriented Processors. *CAMAC Bulletin*, No. 6 (1973) p. 30.
3. Davies M.P.H., Hagan P.J., Hunt R.A., CONCO – A CAMAC Language Assembler, *CAMAC Bulletin*, No. 7 (1973) p. 28.
4. Ward L.D., The Use of the 7025 Programmed Dataway Controller in CAMAC Systems. AERE Harwell, England. Report AERE-R6677 (1971).

BULLETIN ANNOUNCEMENTS

COMPANY NEWSLETTERS

The ESONE Information Working Group is highly appreciative of the individual efforts being made by CAMAC Companies to promote CAMAC and their new products via company newsletters.

Recent arrivals on the scene include:

Jorway News,
GEC CAMAC News,
(GEC-Elliott Process Automation Ltd.)
Kinetic System's Newsletter,

and there are other such as the 'Diary of Developments' by Nuclear Enterprises Limited.

In order to compile a comprehensive list for the next Bulletin of such newsletters that are available, perhaps companies would let Mr. O. Pl. Nicolaysen have the title of their publication.

Readers, in the meanwhile, who have not seen the above should write to the company concerned requesting a copy.

AVAILABILITY OF CAMAC GLOSSARY

All Bulletin subscribers have received together with *CAMAC Bulletin* No. 7 a copy of the Supplement of that issue '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.

NEWS

STANDARD FORTRAN SUBROUTINES (for Executive Functions, Process Input/Output, and File Handling)

The Purdue Workshop on Standardisation of Industrial Computer Languages is working on a set of standard subroutines for executive functions, process input and output, file handling and bit manipulation for use with FORTRAN. To date the work has resulted in one document, ISA-S61.1, *Industrial Computer Systems FORTRAN Procedures for Executive Functions and Process Input-Output.* Two subsequent publications are planned to define procedures for random-access file handling and communication with multitasking executive systems. ISA-S61.1 is available from Instrument Society of America, 400 Stanwyx Street, Pittsburgh, Pennsylvania, USA.

A SERIAL CRATE CONTROLLER

by

F. Buschbeck and E. Neuwirth

Elektronik-Institut, Forschungszentrum Seibersdorf, Austria

Received 14th June 1973

(3)

SUMMARY This paper describes a serial CAMAC crate controller for smaller systems. Each byte is a unique message, thus avoiding problems of message synchronisation. There is a full-duplex link from each crate controller to the computer.

INTRODUCTION

A relatively simple serial crate controller* has been developed, which is controlled by a computer via a teletype port. The Dataway side of the controller is compatible with EUR 4100e, the I/O side is compatible with EIA RS 232 C[1], but the transmission speed may be much higher.

The CCC-2 crate controller[2] and a special encoding principle[3] were used as a basis. For simplicity not all the possibilities offered by this principle have been used as yet.

SYSTEM CONFIGURATION

It is intended that each crate should have its own full-duplex link to the computer (if necessary, using modems). The channel from the computer to CAMAC is called the "write channel"; the opposite one is the "read channel". The active (intelligent) part of the system is usually only the computer.

A local, short distance multiplex system, is just under construction to allow the connection of up to 7 or 15 crates at the end of one link.

GENERAL CHARACTERISTICS

Each data field, such as C, N, A, F, W, and R is uniquely associated with a different key within the same byte, i.e. in each byte the key determines how the content of the byte is interpreted. Thus the key determines which (4 or 5 bit) register should be loaded by the received byte or from which register data should be read. This feature allows the contents of one particular register, to be read or changed without disturbing the contents of any other register. Thus, it is only necessary to transmit those data fields that have to be changed or read.

ENCODING PRINCIPLE

For transmitting a CAMAC write command it is necessary to transmit at least (without check bits) about 40 bits. They must be set into the proper buffer registers. Using 3 or 4 bits in each byte as a key, it is possible to define uniquely the destination of the remaining bits, i.e. C, N, A, F or 4 bit segments of the write data. Fig. 1 gives the "key-content" assignment, which is used in the crate controller.

Key Nr.	Byte name	Key bit Pattern	WRITE-Channel (Central to CAMAC)					READ-Channel (CAMAC to Central)				
	Bit No	8 7 6 5	5	4	3	2	1	5	4	3	2	1
0	D-byte	0 0 0 0		← not to be used →					← demand pattern →			
1	P- "	0 0 0 1		EIP 1)	parity content (Modulo 8)				COD 2)	← parity content →		
2,3	N- "	0 0 1	← N →					← N →				
4,5	F- "	0 1 0	← F →					← F →				
6	C- "	0 1 1 0		← C →					← C →			
7	S1- "	0 1 1 1		DE 1 3)	DE 2 3)	SA 4)	SB 4)		DE 1	DE 2	See Fig. 2 4)	
8	A- "	1 0 0 0		← A →					← A →			
9	D1- "	1 0 0 1		← MSB D1 →					← D1 →			
10	D2- "	1 0 1 0		← D2 →					← D2 →			
11	D3- "	1 0 1 1		← D3 →					← D3 →			
12	D4- "	1 1 0 0		← D4 →					← D4 →			
13	D5- "	1 1 0 1		← D5 →					← D5 →			
14	D6- "	1 1 1 0		← D6 LSB →					← D6 →			
15		1 1 1 1		← 5) →					← 5) →			

1. EIP Execute CAMAC operation, if parity is ok.
2. COD Camac operation done.
3. Automatic 'Demand Byte' Generation enable for the whole branch with encoded (DE1, DE2) enable levels.
4. SA, SB see Fig. 2.
5. Free for individual usage.

Fig. 1 Key and-Content Assignment

SA and SB are decoded together. Fig. 2 shows the reaction of the crate controller to the four possible combinations of SA and SB. This method allows reading the Q or X response or setting the "S-Flip-Flop" and checking this transmission. The content of the "S-Flip-Flop" determines the reaction of the crate controller upon the receipt of a byte (key).

	WRITE-Channel		READ-Channel*		MODE Flip-Flop
	SA	SB	Bit 2	Bit 1	
Key 7	0	0	SA(±0)	SB (±0)	→ Reply mode (S=0)
	0	1	SA(±0)	SB(±1)	→ Set mode (S=1)
	1	0	SA(±1)	Q	no mode change
	1	1	SA(±1)	X	no mode change

* (±0) and (±1) means that respective bit contents '0' and '1' are a condition for errorless system operation.

Fig. 2 SA, SB Decoding Principle

If S = 1 (set mode), the content of each received byte overwrites the appropriate register, while the whole byte is echoed back to the computer (hardware disable is possible) for error checking. If S = 0 (reply mode), the crate controller transmits to the computer the content of the register specified by the received key. For error checking the reply procedure may be repeated.

* This crate controller differs in various important respects from the CAMAC Serial Highway scheme developed by the ESONE and NIM Committees, which is described in this issue (see p. 5).

TRANSMISSION ERROR CHECK

Two methods of error checking are provided and one or both may be used, depending on the quality of the link and the desired degree of reliability of the system.

A modulo-8 parity sum is generated independently by each transmitter and each receiver. A comparison is made in the receiver.

The CAMAC operation is executed only if no error is observed. If there is an error in the write channel, a demand byte is generated. If the computer observes an error in the read channel, it repeats the message.

The parity count recommences after each byte with the parity key (K1).

In set mode, all signals received by the crate controller are echoed to the computer and may be checked there. In reply mode, all data can be read by the computer from the crate controller as many times as desired for comparison purposes.

DEMAND GENERATION

The demand capability of each crate can be enabled by a certain CNAF. The allowed demand level is set by a combination of DE1 and DE2. A branch demand signal (BDE) is only applied to the 'transmission priority logic' if a LAM signal occurs whose priority level (assigned by a LAM grader) is higher than specified by DE1 and DE2. This causes the following bytes in the read channel to be 'demand-bytes'. They consist of key 0 and a 4 bit GL pattern. (It is intended to derive this pattern from a priority logic.)

Receiver parity or framing error also cause emission of demand bytes with a certain GL level.

REACTION TO A DEMAND

In the 'demand byte' there are 4 bits available. They make it possible to transfer 15 differents levels (level 0 should indicate 'no demand') which immediately point to one of 15 servicing routines. These routines may service either a single LAM-source or may be a polling-routine to find out what to do, if more than one LAM-source has been assigned to the level. Anyway, until the servicing routine is finished, demands must be turned off at this level by changing DE1 and DE2 to a higher level.

IMPLEMENTATION OF THE CRATE CONTROLLER

A block diagram of the serial crate controller is shown in Fig. 3.

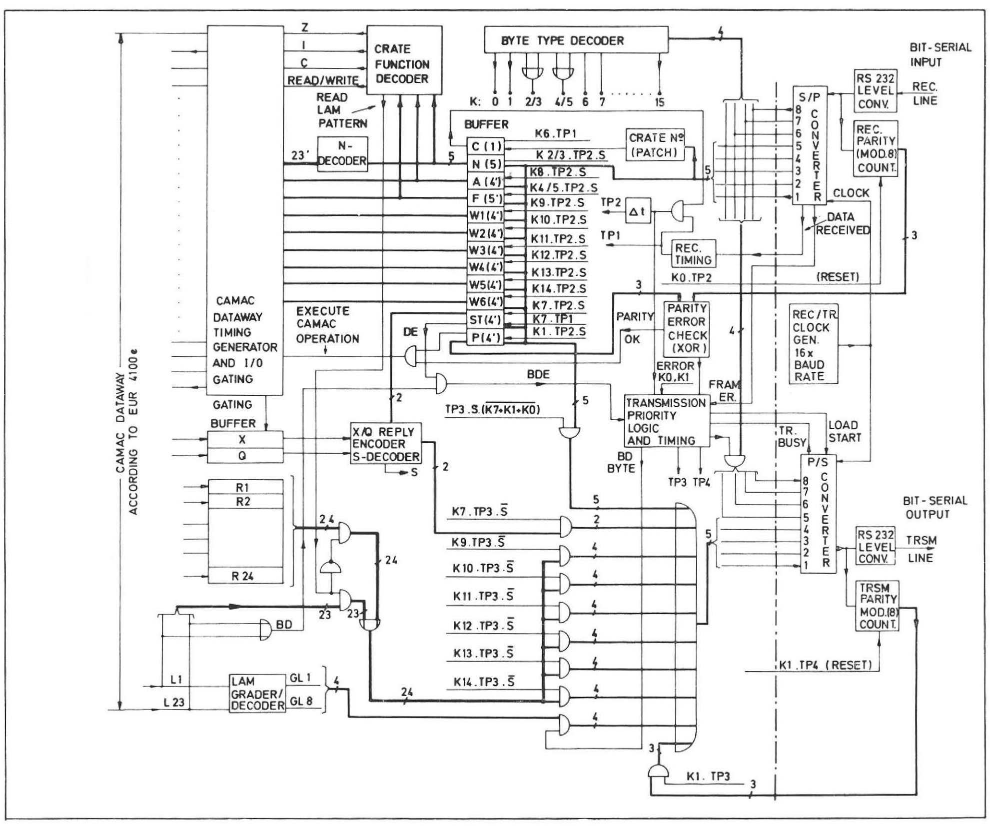

Fig. 3 Block Diagram of the Serial Crate-Controller

Transmission line interface circuits

The external signal transfers are performed at EIA RS 232 C levels in start-stop mode. Level converters and a serial-to-parallel/parallel-to-serial converter, driven by a local clock generator, provide the conversion between external bit-serial and the internal byte-serial structure of the crate controller. Modulo-8 sum parity is generated at both, input and output terminals. A receiver 'framing error' signal is derived. A 'data received' signal starts the receiver timing.

Buffer addressing

Bits 5-8 of the received byte, the keybits, are connected to a 1-of-16 decoder (outputs 2-3 and 4-5 are ORed), which points statically to the address of the buffer register to which the remaining bits (e.g. databits) have to be sent. TP2 is generated only if the crate was addressed. The registers, except crate address and S-mode flip-flop, are only overwritten in 'set mode' (S = 1). The received keybits are echoed to the computer together with the data belonging to them. However, during demand generation the 'demand key' is produced in the crate controller and transmitted, and other signals to the 'read channel' are suppressed.

CAMAC operation

The resulting CAMAC operation is defined by the content of the N, A, and F registers, which are decoded in the 'crate function decoder'. The execution is started only if the locally counted modulo-8 parity coincides with the value received from the computer. The Dataway timing and gating is as required by EUR 4100 e.

Transmission priority logy

This circuit determines which byte will be sent next to the read channel, by controlling the gates for the key and the content. Highest priority is given to the currently transmitted byte, because it should not be interrupted. Next priority is given to a demand, as long as the BDE (enabled branch demand) is applied. The lowest priority is given to the echo of a received byte.

Example

Fig. 4 gives an example of a data transmission between a computer and a CAMAC crate equipped with the serial crate controller.

REFERENCES

1. Interface Between Data Terminal Equipment and Communication Equipment Employing Serial Binary Data Interchange. Electronic Industries Association, Washington D.C., Standard RS 232 C. (1969).
[Note: this is closely related to CCITT Recommendation V24]
2. Attwenger, W., Egl, W., May, F., Patzelt, R., and others, *CAMAC Crate Control for a PDP-8.* Proc. Ispra Nuclear Electronics Symposium, EURATOM Report EUR 4289e (1969) p. 391.
3. Buschbeck, F., Neuwirth, E., Proposal for a CAMAC Multicrate Serial Transmission System. SGAE Report 2138 EL-25/73 (1973).

Byte No.	WRITE-channel (computer to CAMAC)	Key	Content	READ-channel (CAMAC to computer) Key	Content	
1	Sets demand level and mode (S = 1)	7	DE1, DE2, SA, SB			
2	Set C	6	C(4′)	7	DE1, DE2, SA, SB	
3	Set N	2/3	N(5′)	6	C(4′)	
4	Set A	8	A(4′)	2/3	N(5′)	
5	Set F	4/5	F(5′)	8	A(4′)	
6	Set D_1	9	$D_1(4')$	4/5	F(5′)	the echo allows the transmission to be checked
7	Set D_2	10	$D_2(4')$	9	$D_1(4')$	
8	Set D_3	11	$D_3(4')$	10	$D_2(4')$	
9	Set D_4	12	$D_4(4')$	11	$D_3(4')$	
10	Set D_5	13	$D_5(4')$	12	$D_4(4')$	
11	Set D_6	14	$D_6(4')$	13	$D_5(4')$	
12	Computer waits for echo			14	$D_6(4')$	
13	Execute CAMAC op. if parity is ok.	1	1, $P_w(3')$			
14				1	COD, $P_R(3')$	COD = 1: CAMAC operation done

Now the computer knows whether the CAMAC operation was executed properly

Fig. 4 Write Data into a Register of a Module Assumption: Initialization or previous transfer has finished without error

NEWS

ANNOUNCEMENTS BY CAMAC MANUFACTURERS

NUCLEAR ENTERPRISES LIMITED, who currently manufacture one of the largest ranges of CAMAC compatible equipment in Europe, have announced that they are shortly to commence manufacture of CAMAC equipment in the USA.

Mr. B. Payne, one of Nuclear Enterprises' senior CAMAC design engineers, is now at Nuclear Enterprises Inc. plant in San Carlos, near San Francisco, working with the management of the NEI plant to start manufacture of Nuclear Enterprises Limited designed CAMAC modules.

The first units which should be available from the U.S. plant will include the new Input and Output Registers and deliveries are expected to be made during December 1973. The range of CAMAC manufactured at San Carlos will be gradually increased over the next twelve months so as to provide a complete 'in house' systems capability from U.S. manufactured modules.

CAMAC PRODUCT GUIDE

CAMAC Bulletin No. 8

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 1st October 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.

Products are classified according to the new decimal classification system introduced last issue. See Bulletin No. 7 for a description of the classification system.

There are about 150 new entries this time, bringing up the total to some 1050 products.

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.

Remarks on some columns in the Index of Products

Column

N/C – N is new, C is corrected entry.

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

INDEX OF PRODUCTS

NC 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	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	COUNTING REGISTER (1X24BIT,15MHZ,TTL/NIM SIGNALS,EXT INHIBIT IN,CARRY OUT)	7070-1	NUCL. ENTERPRISES	1	/70	
	1X24 BIT BINARY BLIND SCALER (20MHZ NIM OR 10MHZ TTL I/P,EXT INHIBIT IN,OVF O/P)	J EB 10	SAIP/SCHLUMBERGER	1	/71	
	MINISCALER (2X16BIT,30MHZ,SEPARATE GATES AND EXTERNAL RESET,NIM LEVELS)	1002	BORER	1	/69	
	MINISCALER (2X16BIT,30MHZ,SEPARATE GATES AND EXTERNAL RESET,NIM LEVELS)	002	NUCL. ENTERPRISES	1		
	MINISCALER(2X16BIT,30MHZ,SEPARATE GATES AND EXT RESET,NIM LEVELS)	C 104	RDT	1	/71	
	DUAL 150 MHZ 16 BIT SCALER (ONE 50 OHMS, ONE UNTERMINATED NIM INPUT PER SCALER)	2S 2024/16	SEN	1	/70	
	DUAL 24 BIT BINARY SCALER (15MHZ, NIM OR TTL INPUTS)	FHC 1313	BF VERTRIEB	1	/72	
	DUAL 24-BIT COUNTING REGISTER	C-DS-24	WENZEL ELEKTRONIK	1	/72	
	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	
	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)
	MICROSCALER(4X16BIT,2X32BIT SELECTABLE, 25MHZ,COMMON GATE,NIM LEVELS)	C 102	RDT	1	/71	
	4X16 BIT BINARY BLIND SCALER (30 MHZ, 2X32BIT SELECTABLE,COMMON GATE,NIM/TTL)	J EB 20	SAIP/SCHLUMBERGER	1	/71	
	FOUR-FOLD SCALER (4X16BIT,2X32BIT SELECTABLE,50MHZ,COMMON GATE,NIM LEVELS)	4 S 2003/50	SEN	1	/69	
	FOUR-FOLD CAMAC SCALER (4X16BIT,40MHZ, ONE 50 OHMS,ONE HI-Z NIM I/P PER SCALER)	4 S 2004	SEN	1	/70	
	TIME DIGITIZER(4X16BIT,CLOCK RATE 70/85MHZ, WITH CENTER FINDING LOGIC)	TD 2031	SEN	1	/72	
	TIME DIGITIZER (4X16BIT,CLOCK RATE 70/85MHZ,NIM LEVELS)	TD 2041	SEN	1	/72	(4)
	SERIAL REGISTER (4X16BIT,2X32BIT SELECTABLE,100MHZ,COMMON GATE,NIM LEVELS)	SR 1608	GEC-ELLIOTT	1	/71	
	QUAD 100 MHZ SCALER(4X16/24BIT,-0.5V I/P THRESHOLD,COMMON EXT FAST INHIBIT,NIM)	2550B	LRS-LECROY	1	/70	
	FOUR-FOLD SCALER(4X16BIT,2X32BIT SELECTABLE,100MHZ,COMMON GATE,NIM LEVELS)	4 S 2003/100	SEN	1	/70	
	QUAD SCALER (4X24BIT, 50MHZ, DATAWAY AND/OR EXT FAST INHIBIT, NIM LEVELS)	S424S	EG+G	1		(7)
	QUAD COUNTING REGISTER(4X24BIT,NIM INPUT TTL INHIBIT IN,TTL CARRY AND OVF OUT)	709-2	NUCL. ENTERPRISES	1	/71	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	SCALER (4X24BIT, 50MHZ)	9051	NUCL. ENTERPRISES	1	10/73	
	QUAD SCALER (4X24BIT,150/125MHZ,DATAWAY AND/OR EXT FAST INHIBIT,NIM LEVELS)	S424B	EG+G	1	/71	
	QUAD SCALER (4X24BIT, 200MHZ, DATAWAY AND/OR EXT FAST INHIBIT, NIM LEVELS)	S424F	EG+G	1		
N	QUAD COUNTING REGISTER (4X24BIT, 100MHZ, NIM + TTL LEVELS, TTL CARRY OVF, BINARY)	300	HYTEC	1	12/73	
C	QUAD SCALER (4X24BIT, 125MHZ,INTERRUPT STRUCTURE, INDIVIDUAL INHIBITS)	S1	JOERGER	1	/72	(5)
N	QUAD SCALER (4X24BIT, 200MHZ,INTERRUPT STRUCTURE, INDIVIDUAL INHIBITS)	S1-1	JOERGER	1	05/73	
	QUAD 100MHZ SCALER (4X24BIT,DISCR LEVEL -0.5V,TIME-INTERVAL APPL,NIM INHIB I/P)	84	JORWAY	1	/71	(2)
	HEX TTL/NIM 50 MHZ SCALER	3610	KINETIC SYSTEMS	1	01/73	
	HEX NIM 100 MHZ SCALER	3615	KINETIC SYSTEMS	1	04/73	(8)
	OCTAL SCALER (12BITS,8 INPUTS,50MHZ,EACH SCALER GIVES EXT INHIBIT,NIM LEVELS)	S812	EG+G	1	/71	

112 Simple Serial Decade Registers

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	1X6 BCD DECADE SCALER (25 MHZ, BUILT-IN DISPLAY)	J EA 20	SAIP/SCHLUMBERGER	1	04/73	
	DUAL 24 BIT BCD SCALER (15MHZ, NIM OR TTL INPUTS)	FHC 1311	BF VERTRIEB	1	/72	
	DUAL 100 MHZ-6 DECADE BCD SCALER	C 350	INFORMATEK	1	02/73	
	2X6 BCD DECADE SCALER - 100 MHZ WITH REMOTE DISPLAY	J EA 10	SAIP/SCHLUMBERGER	1	/71	
	QUAD SIX-DECADE COUNTER WITH VARIABLE THRESHOLD AND INPUT FILTER, SLOW	1007	BORER	1	/72	(4)
C	QUAD BCD SCALER (4X6 DECADES,30MHZ)	9021	NUCL. ENTERPRISES	1	/71	
N	QUAD COUNTING REGISTER (4X24BIT, 100MHZ, NIM + TTL LEVELS, TTL CARRY OVF, BCD)	301	HYTEC	1	12/73	

113 Preset Serial Binary Registers

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	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	
	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	
	SCALER 300 MHZ (12/16/18/24BIT,PRESET WITH OVF LINE,CONSTANT DEADTIME)	C 72451-A11-A1	SIEMENS	1	/72	
N	DUAL PRESET COUNTING REGISTER(16BIT BIN)	2204	BI RA SYSTEMS	1		
N	DUAL 50 MHZ SCALER-TIMER (24 BITS)	2101	BI RA SYSTEMS	2		
	2X24 BIT PRESET SCALER (100MHZ COUNTING)	J EP 30	SAIP/SCHLUMBERGER	1	04/73	
N	QUAD COUNTING REGISTER (4X24BIT, 500MHZ, NIM + TTL LEVELS, TTL CARRY OVF, BINARY)	310	HYTEC	1	12/73	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	114 Preset Serial Decade Registers					
	REAL TIME CLOCK (3.8 JSEC TO 18.2 HRS, PRESET-TIME AND PRESET-COUNT MODES)	RTC 2014	SEN	1	/71	
	24BIT BCD PRESET-SCALER (12MHZ, NIM OR TTL INPUTS,MANUAL OR DATAWAY PRESET)	FHC 1301	BF VERTRIEB	2	/71	(1)
	24BIT BCD PRESET-SCALER (12MHZ, NIM OR TTL INPUTS,DATAWAY PRESET)	FHC 1302	BF VERTRIEB	1	/71	(1)
	6 BCD DECADE SCALER (MANUAL AND DATAWAY PRESET,1 MHZ, START/STOP OUTPUT)	J EP 20	SAIP/SCHLUMBERGER	2	/71	
	PRESET SCALER (20MHZ,8DECADE BCD,7 SEGM LED INDICATES CONTENTS AND PRESET NO)	PSR 0801	GEC-ELLIOTT	1	/72	(7)
	PRESET SCALER(10MHZ,8 DECADE BCD,DISPLAY OF 2 SIGNIF NUMBERS+EXP,MAN PRESET,NIM)	C 103	RDT	3	/71	
N	DUAL PRESET COUNTING REGISTE(4 DECADES)	2204	BI RA SYSTEMS	1		
N	QUAD COUNTING REGISTER (4X24BIT, 500MHZ, NIM + TTL LEVELS, TTL CARRY OVF, BCD)	311	HYTEC	1	12/73	
	117 Other Digital Serial Input Modules (Bi-Directional Sequential, Shift Types)					
N	DEAD TIME COUNTER	2203	BI RA SYSTEMS	1		
C	UP/DOWN PRESETTABLE COUNTER(24BIT,10MHZ, GATE AND PULSE BURST OUTPUTS)	S2	JOERGER	1	/72	(5)
N	UP/DOWN PRESETTABLE COUNTER(6 BCD DIGITS 10MHZ, MANUAL AND DATAWAY PRESET)	S2-1	JOERGER	1	05/73	
N	QUAD PRESETTABLE UP-DOWN COUNTER	3640	KINETIC SYSTEMS	1	10/73	
	SEQUENTIAL INPUT REGISTER(16 8BIT BYTES, STORES CODED NIM PULSES,0=40,1=150NSEC)	SIRE	SAIP/SCHLUMBERGER	1	/71	
	DUAL INCREMENTAL POSITION ENCODER (2X20 BIT X-Y DIGITIZATION BY UP-DOWN COUNTER)	ZIPE 2019	SEN	1	/71	

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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	121 Non-Storing Registers (Gates)					
	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)
N	PARALLEL INPUT GATE (1X16BIT, TTL)	2411	BI RA SYSTEMS	1		
N	PARALLEL INPUT GATE (1X24BIT, TTL)	2421	BI RA SYSTEMS	1		
N	INPUT GATE (24BIT, SOURCE SELECTION BY 6BIT OUTPUT, DATAWAY GEN STROBE OUT)	J 007	JORWAY	0		(8)
	INPUT GATE 24-BIT	3420	KINETIC SYSTEMS	1	/71	(4)
	PARALLEL INPUT GATE (24BIT STATIC DATA, INTEGRATED FOR 1 USEC,TTL LEVELS)	7059-1	NUCL. ENTERPRISES	1	/70	
	PARALLEL INPUT GATE (22BIT STATIC DATA, 500 NSEC INTEGRATION,STROBE SETS L,TTL)	7060-1	NUCL. ENTERPRISES	1	/70	
N	24-BIT ISOLATED INPUT GATE	3471	KINETIC SYSTEMS	1	/73	
N	PARALLEL INPUT GATE (2X16BIT, TTL)	2412	BI RA SYSTEMS	1		
	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		
C	DUAL 24 BIT PARALLEL INPUT GATE (WITH LED DISPLAY OPTION)	PG-604	STND ENGINEERING	1	/72	(6)
	PARALLEL INPUT GATE (3X16BIT INPUT FROM ISOLATING CONTACTS)	1061	BORER	1	/72	(4)
N	3X16-BIT INPUT GATE (INPUTS ISOLATED BY OPTO-COUPLERS)	1063	BORER	1	05/73	(8)
	DIGITALES EINGANGSREGISTER MIT OPTOKOPPLER(4X8BIT PARALLEL INPUT GATES,WITH L)	DO 200-2003	DORNIER	1	/72	
	(WITH FRONT PANEL CONNECTOR)	DO 200-2203		1	/72	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	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	
	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	
N	(WITHOUT WIRING BOARD)	DO 200-2000		1	12/73	
	DIGITALES EINGANGSREGISTER(5X8BIT PARALL INPUT GATES,5TH BYTE SETS L,H-L,1=H)	DO 200-2002	DORNIER	1	/72	
	(WITH FRONT PANEL CONNECTOR)	DO 200-2202		1	/72	

122 Storing Registers

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	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)
N	PARALLEL INPUT REGISTER (1X16BIT, TTL)	2311	BI RA SYSTEMS	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)
	INPUT REGISTER (24BIT, SPEC CONN, 8 BIT ALSO VIA LEMO,LAM ON NON-ZERO OR STROBE)	FHC 1308	BF VERTRIEB	1	/71	
N	PARALLEL INPUT REGISTER (1X24BIT, TTL)	2321	BI RA SYSTEMS	1		
	INPUT REGISTER 24-BIT	3470	KINETIC SYSTEMS	1	/71	(4)
	BALANCED INPUT REGISTER WITH ADDRESSING	3430	KINETIC SYSTEMS	1	/72	(8)
N	PARALLEL INPUT REGISTER (2X16BIT, TTL)	2312	BI RA SYSTEMS	1		
	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 24 BIT PARALLEL INPUT REGISTER(TTL)	2322	BI RA SYSTEMS	1	04/73	
N	DUAL 24 BIT PARALLEL INPUT REGISTER(TTL)	2322A	BI RA SYSTEMS	1		
	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	
N	DUAL INPUT REGISTER (2X24BIT, INPUT INTEG TTL INPUT, +AND- LOGIC)	221	HYTEC	1	11/73	
	DUAL PARALLEL INPUT REGISTER(2X24BIT,EXT LOAD REQUEST,4 OPER MODES,TTL LEVELS)	60	JORWAY	1	/70	
	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/SCHLUMBERGER	1	04/73	(7)
C	DUAL 24 BIT PARALLEL INPUT REGISTER (WITH LED DISPLAY OPTION)	PR-604	STND ENGINEERING	1	/72	
N	DUAL INPUT REGISTER (2X24BIT,INPUT INTEG TTL SCHMITT TRIG I/P, +AND- LOGIC)	220	HYTEC	1	11/73	
N	INPUT REGISTER (2X24BIT, HIGH IMPEDANCE I/P, LED DISPLAY, 2X6BIT O/P REG OPTION)	IR	JOERGER	1	/72	(7)
	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	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR

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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	COINCIDENCE LATCH (24 NIM INPUTS WITH COMMON STROBE, EXT RESET, 2NSEC OVERLAP)	C124	EG+G	2		
	12 BIT PARALLEL INPUT REGISTER (NIM)	2351	BI RA SYSTEMS	1	04/73	
N	8-BIT INPUT REGISTER (NIM)	3473	KINETIC SYSTEMS	1	01/74	
	STROBED INPUT REGISTER (12BIT COINC AND LATCH,NIM LEVELS,PATTERN AND L-REQ APPL)	SIR 2026	SEN	1	/70	
	FAST COINCIDENCE LATCH(16BIT,DISCR I/P, MIN 2 NSEC STROBE-SIGNAL OVERLAP)	64	JORWAY	1	/71	(1)
	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)
C	16-CH COINCIDENCE REGISTER (STROBE I/P, 2NS OVERLAP,FAST SUM O/P AND CLEAR,NIM)	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	
	16 BIT PATTERN UNIT (NIM I/P AND GATE)	J PU 10	SAIP/SCHLUMBERGER	1	/72	
	PATTERN UNIT 16 BIT (16 INDIVIDUAL NIM INPUTS,COMMON NIM GATE, CERN SPECS 021)	16P 2007	SEN	2	/70	
	16 BIT PATTERN UNIT (CERN SPECS 071, 16 INDIVIDUAL NIM INPUTS,COMMON NIM GATE)	16P 2047	SEN	1	/72	(6)
	COINCIDENCE BUFFER (2X12BIT,ONE STROBE PER 12BITS,MIN 2NS OVERLAP,NIM INPUTS)	C212	EG+G	2	/71	
	DUAL 16 BIT FAST LATCH(FAST NIM/ECL I/P, STROBE FOR EACH CHANNEL, 5 NSEC OVERLAP)	PR 1605	GEC-ELLIOTT	1	05/73	

124 Manual Input Modules (Word Generators, Parameter Units)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	PARAMETER UNIT 12 BIT (PROVIDES 12 BIT COMMUNICATION,PUSH BUTTON L-REQUEST)	P 2005	SEN	1	/70	
N	MANUAL INPUT REGISTER (INPUTS A HAND-SET 16-BIT WORD, MANUAL AND ELECTR LAM I/P)	1041	BORER	1	06/73	(8)
	DATA SWITCHES (16/24 BITS,READABLE + CONTENT ADDR)	C 322	INFORMATEK	1	/72	
N	24 BIT PARAMETER UNIT	2501	BI RA SYSTEMS	1		
	WORD GENERATOR (24BIT WORD MANUALLY SET BY SWITCHES)	WG 2401	GEC-ELLIOTT	1	/71	
N	24-BIT MANUAL INPUT	3460	KINETIC SYSTEMS	1	/73	
	WORD GENERATOR (24 BITS OF BINARY DATA, SWITCH SELECTED)	9020	NUCL. ENTERPRISES	1	/71	(2)
C	24 BIT WORD GENERATOR , WITH LAM	WGR-241	STND ENGINEERING	1	08/73	
	PARAMETER UNIT (QUAD 4-DECADE BCD PARAMETERS MANUALLY SET)	022	NUCL. ENTERPRISES	4	/71	(2)
	PARAMETER UNIT (QUAD 4 DECADE BCD PARAMETERS MANUALLY SET)	C 105	RDT	4	/71	

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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	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	
	INTERRUPT REQUEST REGISTER (8BIT, TTL INPUTS TO REGISTER,ANY INPUT GIVES LAM.	7013-1	NUCL. ENTERPRISES	1	/70	
C	INTERRUPT REQUEST REGISTER	EC 218	NUCL. ENTERPRISES	1		
	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)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	.WIDTH	DELIV.	NPR
N	TIMER MODULE	3655	KINETIC SYSTEMS	1	10/73	
	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)
	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	
	1 HZ - 1 MHZ QUARTZ CLOCK (7 O/P - 1HZ TO 1MHZ-200 TO 800 NSEC WIDTH,TTL LEVEL)	J HQ 10	SAIP/SCHLUMBERGER	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	
	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)
	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	
	SEQUENTIAL OUTPUT REGISTER (SERIAL-CODED NIM PULSES OUT,LOGIC 0=40NSEC,1=150NSEC)	SOR	SAIP/SCHLUMBERGER	1	/71	

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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	.WIDTH	DELIV.	NPR
	12 BIT PARALLEL OUTPUT REGISTER (NIM)	3251	BI RA SYSTEMS	1	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	
N	16 BIT PARALLEL OUTPUT REGISTER (TTL)	3211	BI RA SYSTEMS	1		
	DIFFERENTIAL OUTPUT REGISTER	3030	KINETIC SYSTEMS	1	/72	(8)
	OUTPUT REGISTER (16BIT)	360	POLON	1	09/73	
N	PARALLEL OUTPUT REGISTER (16BIT)	C-OB-16	WENZEL ELEKTRONIK	0		
	OUTPUT REGISTER (24BIT TTL VIA SPEC CONN 8BIT ALSO VIA FRONT PANEL LEMO)	FHC 1309	BF VERTRIEB	1	/72	
N	24 BIT OUTPUT REGISTER (TTL)	3221	BI RA SYSTEMS	1		
	PARALLEL OUTPUT REGISTER (24BIT TTL OUTPUT VIA 25-WAY CONNECTOR)	7054-3	NUCL. ENTERPRISES	1	/70	
	OUTPUT REGISTER (24BIT)	351	POLON	1	09/73	
N	DUAL 16BIT PARALLEL OUTPUT REGISTER(TTL)	3212	BI RA SYSTEMS	1		
	OUTPUT REGISTER (2X16BIT)	352	POLON	1	09/73	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	OUTPUT REGISTER (2X16BIT VIA ISOLATING CONTACTS)	1082	BORER	1	/72	
	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)
C	DUAL OUTPUT REGISTER (2X24BIT, DATAWAY READ AND WRITE, HANDSHAKE CONTROL, LO-Z)	9043A	NUCL. ENTERPRISES	1		(7)
C	DUAL OUTPUT REGISTER (2X24BIT, DATAWAY READ AND WRITE, HANDSHAKE CONTROL, HI-Z)	9043B		1		(7)
	OUTPUT REGISTER (2X24BIT)	353	POLON	2	09/73	
	PARALLEL OUTPUT REGISTER (2X24 BITS)	J RS 10	SAIP/SCHLUMBERGER	1	04/73	(7)
C	DUAL 24 BIT PARALLEL OUTPUT REGISTER (WITH LED DISPLAY OPTION)	PR-612	STND ENGINEERING	1	/71	(6)
	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	
N	(WITHOUT WIRING BOARD)	DO 200-2500		1	12/73	
N	DIGITALES AUSGANGSREGISTER(4X8BIT PARALL OUPTPUT REGISTER, HLL 12V)	DO 200-2505	DORNIER	1	12/73	
N	(WITH FRONT PANEL CONNECTOR)	DO 200-2705		1	12/73	
N	DIGITALES AUSGANGSREGISTER(4X8BIT PARALL OUPTPUT REGISTER, HLL 12V,INVERTING)	DO 200-2506		1	12/73	
N	(WITH FRONT PANEL CONNECTOR)	DO 200-2706		1	12/73	
N	DIGITALES AUSGANGSREGISTER(4X8BIT PARALL OUPTPUT REGISTER, HLL 24V)	DO 200-2507		1	12/73	
N	(WITH FRONT PANEL CONNECTOR) L	DO 200-2707		1	12/73	
N	DIGITALES AUSGANGSREGISTER(4X8BIT PARALL OUPTPUT REGISTER, HLL 24V, INVERTING)	DO 200-2508		1	12/73	
N	(WITH FRONT PANEL CONNECTOR) L	DO 200-2708		1	12/73	
	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	
	OUTPUT REGISTER (32X24BIT, EX. ADDRESS)	104	HYTEC	1		
	OUTPUT REGISTER (16X24BIT, EX. ADDRESS)	105		1		
N	OUTPUT REGISTER (256X24BIT, EX ADDRESS)	111		1	06/73	

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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	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)
	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	
	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)
N	PARALLEL OUTPUT REGISTER (16BIT)	C-OA-16	WENZEL ELEKTRONIK	0		
N	RELAY DRIVER (16 WAY RELAY OUTPUT)	J RD 10	SAIP/SCHLUMBERGER	1	06/73	(8)
	DIGITAL OUTPUT 16 BIT RELAYS	C 76451-A9-A2	SIEMENS	0		(6)
	DRIVER (24BIT OUTPUT REGISTER,SET AND READ BY COMMAND,24BIT I/P DATA ACCEPTED)	9013	NUCL. ENTERPRISES	1	/71	
	DRIVER (24BIT OUTPUT REGISTER,SET AND READ BY COMMAND,24BIT I/P DATA ACCEPTED)	9017	NUCL. ENTERPRISES	1	/71	(1)
	OUTPUT 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	
	PARALLEL-OUTPUT-REGISTER (DUAL 24BIT, OR QUAD 12BIT,OPEN COLLECTOR OUTPUT)	MS PO 1 1230/1	AEG-TELEFUNKEN	1	/70	(1)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	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	
N	DUAL OUTPUT REGISTER (2X24BIT, OPEN COLL OUTPUTS, 150MA/50V, DATAWAY READ)	200	HYTEC	1	10/73	
N	OUTPUT REGISTER (2X24BIT OR 6X8BIT, 250MA SINKING, DIODE CLAMPED)	OR-1	JOERGER	1	07/73	
	DUAL 24 BIT OUTPUT REGISTER(DC OR PULSE O/P,UPDATING O/P STROBE,TTL OPEN COLL)	40	JORWAY	1	/71	(2)
	DUAL 24-BIT OUTPUT REGISTER (OPEN COLL DRIVERS, MAX 24V OR 250MA, REAR OUTPUTS)	3072	KINETIC SYSTEMS	1		
	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	

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

142 Parallel I/O Registers (General Purpose)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	UNIVERSAL INPUT/OUTPUT REGISTER (36BIT DATA+RANGE IN,12BIT REG O/P FOR CONTROL)	1031	BORER	1	/72	(3)
C	PARALLEL I/O REGISTER (32X24BIT)	100	HYTEC	1		
N	PARALLEL I/O REGISTER (32X16BIT)	101		1	/72	
N	PARALLEL I/O REGISTER (16X24BIT)	102		1	/72	
N	PARALLEL I/O REGISTER (256X24BIT)	112		1	/73	
	DUAL INPUT DUAL OUTPUT REGISTER (16BIT, TTL IN, OPEN COLL TTL OUT, MAX 40MA,30V)	C110	RDT	1	/72	
C	INPUT/OUTPUT REGISTER (2X24BIT IN,2X8BIT O/P, HI-Z INPUT, LED DISPLAY)	IR-1	JOERGER	1	/72	(7)

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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	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	
	TELETYPE O/P CTRL (TO FHC 1301/02/11 AND FHC 1309 VIA SPEC CONN,TTY MOTOR ON/OFF)	FHC 1307	BF VERTRIEB	1	/71	(1)
	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	03/73	
	TELETYPE DRIVER	J TY 10	SAIP/SCHLUMBERGER	1	06/73	(8)
	TELETYPE INTERFACE	C-T-33	WENZEL ELEKTRONIK	1	/72	
	VERSATEC LINE PRINTER INTERFACE	3320	KINETIC SYSTEMS	1	/72	
	PAPER TAPE PUNCH OUTPUT DRIVER (FOR FACIT 4070)	TP 0801	GEC-ELLIOTT	1	06/73	(1)
	TAPE READER INTERFACE UNIT (FOR ELECTROGRAPHIC READER)	TR 0801	GEC-ELLIOTT	1	06/73	(1)
N	MAGNETIC TAPE INTERFACE (TAPE DECKS OR CASSETTES)	CS 0042	NUCL. ENTERPRISES	1	/73	(8)
	UNIVERSAL ASYNCHRONOUS TRANSMITTER/RECEIVER (128 CHAR.BUFFER)	C 317	INFORMATEK	1	03/73	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	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	
	SCALER DISPLAY THROUGH COMPUTER (DISPLAY OF 24BIT WORD)	J AF 15	SAIP/SCHLUMBERGER	2	/71	
	MANUAL BINARY DISPLAY (CONTENT OF A REGISTER DISPLAYED,EXT MULTIWAY CONN)	J AF 20	SAIP/SCHLUMBERGER	1	/71	
N	GRAPHIC DISPLAY DRIVER FOR HP1311/TEK502	4301	BI RA SYSTEMS	0		
	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	
N	COLOR MONITOR	RGB 1200 M			/71	
	STORAGE DISPLAY DRIVER	3260	KINETIC SYSTEMS	1	/72	
	DISPLAY DRIVER (TWO 10BIT DAC,OUTPUT RANGE +5V TO -5V,TWO OPERATION MODES)	7011-2	NUCL. ENTERPRISES	2	/70	(1)
	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	
C	STORAGE OSCILLOSCOPE (DRIVER FOR TEKTRONIX 611 OR 601,USED WITH 7011)	9028	NUCL. ENTERPRISES	1	/71	(2)
	SCOPE DISPLAY DRIVER	J DD 10	SAIP/SCHLUMBERGER	2	04/73	(7)
	MANUAL CONTROL OF J DD 10	MC 10		NA		
	EXTERNAL DISPLAY FOR J EA 10 SCALER	C AE 10	SAIP/SCHLUMBERGER	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	
N	RECORDER DRIVER	J XY.10	SAIP/SCHLUMBERGER	1	06/73	(8)
	THE WDV 3300 INTERACTIVE GRAPHICS SYSTEM COMPRISING		WDV			
	DISPLAY UNIT	WDV 1855		0		
	LIGHT PEN	WDV 1851		0		
	GRAPHIC DATASENSOR	WDV 1833 G		0		

X

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	145 Instrumentation Interfacing Modules (DVM, Supply CTR, Stepping Motor Drivers, Pulse Analyser CTR)					
C	DUAL CHANNEL SERIAL OUTPUT MODULE	3101	BI RA SYSTEMS	2	04/73	
N	DUAL CHANNEL SERIAL OUTPUT MODULE	3102	BI RA SYSTEMS	2	04/73	
N	DUAL 8 CHANNEL SERIAL OUTPUT MODULE	3106	BI RA SYSTEMS	2	04/73	
N	DUAL 8 CHANNEL SERIAL OUTPUT MODULE	3107	BI RA SYSTEMS	2	04/73	
	STEP MOTOR DRIVER (MAX 32758 STEPS,RATE, ROTATION AND START/STOP FULLY COMMANDED)	1161	BORER	1	/72	(3)
	STEPPING MOTOR CONTROLLER, DUAL	3360	KINETIC SYSTEMS	1	/72	(4)
N	STEPPING MOTOR CONTROLLER	3361	KINETIC SYSTEMS	1	10/73	
	STEPPING MOTOR DRIVER (USED WITH 7045)	0709	NUCL. ENTERPRISES	1	/71	
	DELAYED PULSE GENERATOR (4 TTL O/P,0.042 HZ-40KHZ RATE,LEVEL AND DIRECTION CONTR)	7045-1	NUCL. ENTERPRISES	1	/70	
	STEPPING MOTOR DRIVER	J CP 10	SAIP/SCHLUMBERGER	1	01/73	
C	STEPPER CONTROLLER (CONTINUOUS)	C-ST-4	WENZEL ELEKTRONIK	2	/72	
C	STEPPER CONTROLLER - INCREMENTAL MOTOR	C-ST-4-I	WENZEL ELEKTRONIK	2	/72	
C	POWER SUPPLY CONTROLLER 12-BIT	3158	KINETIC SYSTEMS	1	/73	
N	CAMAC-TO-SCIPP MCA INTERFACE	2323	BI RA SYSTEMS	2		
N	INTERFACE CAMAC-TO-LABEN 8000SERIES MULTICHANNEL ANALYZERS	5380	LABEN	3		
C	MULTICHANNEL ANALYZER - CAMAC INTERFACE (FOR PACKARD 9000 AND 900 SERIES MCA)	9701	PACKARD	3		(4)
	CAMAC INTERFACE FOR CA25/CA13/C97 ADC	J CCA 10	SAIP/SCHLUMBERGER	2	/71	
	DUAL INCREMENTAL POSITION ENCODER (2X20 BIT X-Y DIGITIZATION BY UP-DOWN COUNTER)	2IPE 2019	SEN	1	/71	
	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(64X15BIT MEMORY STORES 13BIT POSITION+3BIT CLUSTER DATA)	WCS-200	NANC 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/SCHLUMBERGER	2	/71	
	SPARK CHAMBER READ OUT (POSITION AND ADDRESS CODING OF MULTIPLE SPARK SITES)	J SC 10/SCRO-041	SAIP/SCHLUMBERGER	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/SCHLUMBERGER	1	/71	(6)
	PLUMBICON READ OUT TERMINAL	J PG 10/PUDDING		1	/71	(6)
N	ADC/CAMAC INTERFACE (FOR INHOUSE ADCS, 2X16BIT O/P BUFFER,STATUS + LAM HANDL)	C-A1-2	WENZEL ELEKTRONIK	0		
	147 Other Digital I/O Modules (Incl. Data Links)					
	START-STOP CONTROLLER(START,STOP,RESET, MANUAL OR DATAWAY CONTROL, 100HZ CLOCK)	FHC 1304	BF VERTRIEB	1	/71	(1)
N	FERNUEBERTRAGUNSANSCHLUSS (V24/V23/V21 MODEM INTERFACE WITH AUTO-DIAL OPTION)	DO 200-2311	DORNIER	1	12/73	
	SENSOR (INTER. UP TO 65.000 GROUPS OF 16/32 BITS, READS PATTERNS OR ADDRESSES)	C 347	INFORMATEK	1	04/73	
N	SERIAL INTERFACE (V24 SPEC)	9045	NUCL. ENTERPRISES	1	08/73	
	TRANSMISSION LINE DRIVER		POLON	0		
	START-STOP UNIT (START, STOP CLOCK AND GATE OUTPUTS)	J AM 10	SAIP/SCHLUMBERGER	1	/71	
	FOUR FOLD BUSY DONE (START SIGNAL INITIATED BY COMMAND,DEVICE RETURNS LAM)	4BD 2021	SEN	1	/71	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR

15 Digital Handling and Processing Modules — and/or/not Gates, Fan-Outs, Digital Level and Code Converters, Buffers, Delays, Arithm. Processors etc.

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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	FAN-OUT UNIT (2 ORED INPUTS PROVIDE 8 TRUE,2 COMPLEM OUTPUTS,NIM SIGNALS)	FO 0301	GEC-ELLIOTT	1	/71	
N	FAN OUT MODULE (IL2 I/P, 16 IL2 O/P)	9050	NUCL. ENTERPRISES	1	11/73	
	SIX-FOLD CONTROLLED GATE (INDIV GATING, FAN-IN AND FAN-OUT CONTROLLED BY 3 REGS)	6CG 2017	SEN	1	/71	(4)

152 Digital Level Converters

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	6 CHANNEL TTL/NIM CONVERTER	5601	BI RA SYSTEMS	1	04/73	
	6 CHANNEL NIM/TTL CONVERTER	5602	BI RA SYSTEMS	1	04/73	
	HEX NIM TO TTL CONVERTER	3450	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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	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)
C	BINARY CODE CONVERTER(BIN-BCD OR BCD-BIN CONVERSION, DATA FROM DATAWAY OR FRONT)	9044	NUCL. ENTERPRISES	1		(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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
C	OUTPUT REGISTER (256X24BIT, RAM + 32X24	110	HYTEC	1		
N	OUTPUT REGISTER (256X24BIT, RAM + 64X24 BIT ROM, EX ADDR , FOR USE WITH 7025-2)	110A		1		
N	A/D, 12BIT BCD, 16 WAY MULTIPLEXER, 16X24BIT STORE, 100USEC/CHANNEL UPDATE)	500	HYTEC	1	12/73	
	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		
C	BUFFER MEMORY (256 16BIT WORDS, USE WITH J CAN 21/C/H)	J MT 20	SAIP/SCHLUMBERGER	1	/72	

155 Logic and Arithmetic Processing Modules

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	FLOATING POINT ARITHMETIC INTERFACE (FOR USE WITH M 128 HARD. FLOAT. POINT)	C 327	INFORMATEK	1	01/73	

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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR

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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	32 CHANNEL ANALOG DATA SYSTEM (EXPANDABLE WITH ADDITIONAL MUX MODULES)	5301	BI RA SYSTEMS	2		
	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)
N	ANALOGUE TO DIGITAL CONVERTER (20MHZ)	CS 0046	NUCL. ENTERPRISES	1	10/73	
	ANALOGUE TO DIGITAL INTEGR. CONVERTER	700	POLON	1	09/73	
	VOLTAGE - FREQUENCY CONVERTER (USED WITH MULTIPLEXERS J MX 10/20)	J CTF 10	SAIP/SCHLUMBERGER	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	
	DIGITAL VOLTMETER (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		
	ANALOGE EINGAENGE(MULTIPLEXER-ADC, 8 DIFF I/P,+/-10V RANGE,7BITS/10V+SIGN)	DO 200-1013	DORNIER	2	/72	
	ANALOGE EINGAENGE(MULTIPLEXER-ADC, TO ONE ADC,+/-5V RANGE,7BITS/ 5V+SIGN)	DO 200-1016	DORNIER	2	/72	
	ANALOGE EINGAENGE(MULTIPLEXER-ADC, 8 DIFF I/P, +10V RANGE,8BITS/10V)	DO 200-1019	DORNIER	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	
N	DUAL 10 BIT A/D	5304	BI RA SYSTEMS	1		
N	SUCCSESS. APPROX. ADC (WITH SAMPLE AND HOLD, -5V TO +5V, 10-BIT)	1244	BORER	2	06/73	
	DUAL 10 BIT ANALOG TO DIGITAL CONVERTER	3515	KINETIC SYSTEMS	1	03/73	
	DUAL SLOPE ADC (+AND- 0.01/1/10V RANGES, 11BIT RESOLUTION,20MS CONV TIME)	1241	BORER	2	/72	(3)
C	SUCCESS. APPROX. ADC (WITH SAMPLE AND HOLD, -1V TO +1V, 12-BIT)	1243	BORER	2	/72	
	ANALOGE EINGAENGE (MULTIPLEXER-ADC, 8 DIFF I/P,+/-10V RANGE,11BITS/10V+SIGN)	DO 200-1003	DORNIER	2	/72	
	ANALOGE EINGAENGE(MULTIPLEXER-ADC, 8 DIFF I/P,+/-5V RANGE,11BITS/ 5V+SIGN)	DO 200-1006	DORNIER	2	/72	
	ANALOGE EINGAENGE(MULTIPLEXER-ADC, 8 DIFF I/P, +10V RANGE, 12BITS/10V)	DO 200-1009	DORNIER	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	
N	A/D, 12BIT BCD, 16 WAY MULTIPLEXER, 16X24BIT STORE, 100USEC/CHANNEL UPDATE)	500	HYTEC	1	12/73	
	A/D CONVERTER (12BIT,MAX 20 USEC CONVERSION, +AND-5V, +AND-10V, +10V RANGES)	30	JORWAY	2	/71	(2)
	DUAL 12 BIT ANALOG TO DIGITAL CONVERTER	3520	KINETIC SYSTEMS	1	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	
	ANALOGER EINGANG(DUAL SLOPE ADC, +/-10V RANGE,14BITS/10V+SIGN,0.2SEC CONVERSION)	DO 200-1021	DORNIER	1	/72	
	OCTAL CHARGE DIGITIZER (8X8BIT CHARGE SENSITIVE ADC, READOUT IN 4X16BIT WORDS)	QD808	EG+G	0		(7)
	MULTI-MODE LINEAR ADC (8BIT,40MHZ CLOCK, AREA AND PEAK MODES,NIM LEVELS)	2243A	LRS-LECROY	1	/70	(2)
C	OCTAL ADC (8 FAST I/P,8BIT/CH, COMMON GATE, NIM LEVELS, BILINEAR MODE)	2248	LRS-LECROY	1	/71	
	OCTAL ADC (MIN 5 NSEC PULSES, POS OR NEG 8BIT/100 PC RESOLUTION, 250 USEC CONV)	9040	NUCL. ENTERPRISES	1	/72	(4)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	ADC - MEMORY INTERFACE (FOR J CAN 20/21 AND BM 96)	J CAN 20 I	SAIP/SCHLUMBERGER	2	/71	
	16.000 CHANNEL PULSE ADC (200MHZ CLOCK)	J CAN 21 C/H	SAIP/SCHLUMBERGER	6	/72	(6)
	1024 CHANNEL PULSE ADC (100MHZ CLOCK)	J CAN 40	SAIP/SCHLUMBERGER	2	/72	(6)
	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,130USEC 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	
N	DUAL SYNCHRO-DIGITAL CONVERTER (14BIT)	CS 0047	NUCL. ENTERPRISES	2	10/73	

162 Analogue Output Modules (DAC)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	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	
N	ANALOGER AUSGANG (DAC 8BIT RESOLUTION, +10V OUTPUT RANGE, 5MA)	DO 200-1511	DORNIER	1	12/73	
N	(SAME BUT 12BIT RESOLUTION)	DO 200-1521		1	10/73	
N	ANALOGER AUSGANG (DAC 8BIT RESOLUTION, +10V OUTPUT RANGE, 5MA, 2 OUTPUTS)	DO 200-1512	DORNIER	1	12/73	
N	(SAME BUT 12BIT RESOLUTION)	DO 200-1522		1	10/73	
N	ANALOGER AUSGANG (DAC 8BIT RESOLUTION, +AND-10V OUTPUT RANGE, 5MA)	DO 200-1513	DORNIER	1	12/73	
N	(SAME BUT 12BIT RESOLUTION)	DO 200-1523		1	10/73	
N	ANALOGER AUSGANG (DAC 8BIT RESOLUTION, +AND-10V OUTPUT RANGE, 5MA, 2 OUTPUTS)	DO 200-1514	DORNIER	1	12/73	
N	(SAME BUT 12BIT RESOLUTION)	DO 200-1524		1	10/73	
N	ANALOGER AUSGANG (DAC 8BIT RESOLUTION, +AND-5V OUTPUT RANGE, 5MA)	DO 200-1515	DORNIER	1	12/73	
N	(SAME BUT 12BIT RESOLUTION)	DO 200-1525		1	10/73	
N	ANALOGER AUSGANG (DAC 8BIT RESOLUTION, +AND-5V OUTPUT RANGE, 5MA, 2 OUTPUTS)	DO 200-1516	DORNIER	1	12/73	
N	(SAME BUT 12BIT RESOLUTION)	DO 200-1526		1	10/73	
N	ANALOGER AUSGANG (DAC 8BIT RESOLUTION, +10V OUTPUT RANGE, 5MA, 4 OUTPUTS)	DO 200-1517	DORNIER	1	12/73	
N	(SAME BUT 12BIT RESOLUTION)	DO 200-1527		1	10/73	
N	ANALOGER AUSGANG (DAC 8BIT RESOLUTION, +AND-10V OUTPUT RANGE, 5MA, 4 OUTPUTS)	DO 200-1518	DORNIER	1	12/73	
N	(SAME BUT 12BIT RESOLUTION)	DO 200-1528		1	10/73	
N	ANALOGER AUSGANG (DAC 8BIT RESOLUTION, +AND-5V OUTPUT RANGE, 5MA, 4 OUTPUTS)	DO 200-1519	DORNIER	1	12/73	
N	(SAME BUT 12BIT RESOLUTION)	DO 200-1529		1	10/73	
N	CAMAC BINARY-TO-BCD CONVERTER WITH DECIMAL DISPLAY	LEM-52/5.8	EISENMANN	1		
	OCTAL DAC (8 CHANNELS,10BIT 5V 500HMS OR 2 S CMPL 9BIT+SIGN, +AND- 5V, 10 USEC)	DAC 1081	GEC-ELLIOTT	1	04/73	(7)
N	DUAL D/A CONVERTER (10 BIT, 10USEC CONV TIME, +10V, +AND-10V, +AND-5V RANGES)	D/A-10	JOERGER	1	09/73	
N	DUAL D/A CONVERTER (12 BIT, 30USEC CONV TIME, +10V, +AND-10V, +AND-5V RANGES)	D/A-12	JOERGER	1	09/73	
	D/A CONVERTER (12BIT,5 USEC CONVERSION, O/P RANGES +AND-2.5V/5V/10V AND +5V/10V)	31	JORWAY	1	/71	(2)
	8 CHANNEL 10 BIT D-A CONVERTER	3110	KINETIC SYSTEMS	1	/72	
	CAMAC ADC/DAC UNIT (PC CARD FOR SAMPLE-HOLD 12BIT ADC AND DAC CIRCUITS)	MC 5200	MICRO CONSULTANTS	1	/72	(6)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	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	
	VOLTAGE CALIBRATOR	J ET 10	SAIP/SCHLUMBERGER	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		
	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)

164 Analogue Handling and Processing Modules I (MX)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	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)
	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 (16 CHANNELS,REED RELAYS,MAN AND DATAWAY SEL, EXPANDABLE)	AM	JOERGER	2	/72	(6)
	15 CHANNEL RELAY MULTIPLEX	3530	KINETIC SYSTEMS	2	01/73	
N	MASTER MULTIPLEXER (16 CH, 4 POLE REED)	601	NUCL. ENTERPRISES		/70	
N	SLAVE MULTIPLEXER (16 CH, 4 POLE REED)	600			/70	
	16 CHANNEL RELAY MULTIPLEXER STANDARD LEVEL)	J MX 10	SAIP/SCHLUMBERGER	1	04/73	
	(SAME FOR LOW LEVEL)	J MX 20		1	04/73	
	MULTIPLEXER MANUAL CONTROL	J AX 10		1	04/73	
	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	
	MULTIPLEXER-SOLID STATE (16 SINGLE-ENDED OR 8 DIFF CHAN,RANDOM OR SEQUENT ACCESS)	9026	NUCL. ENTERPRISES	1	/71	
	MULTIPLEXER (32 CHANNEL, 2 CONTACTS)	C 76451-A4-A1	SIEMENS	2		
	MULTIPLEXER (32 CHANNEL, 4 CONTACTS)	C 76451-A4-A2	SIEMENS	2		
	ELEKTRONISCHER MULTIPLEXER (32 CHANNELS, MAX +OR-10V, DATAWAY SET+INCR ADDRESS)	DO 200-1032	DORNIER	1	/72	
	(WITH FRONT PANEL CONNECTOR)	DO 200-1232		1	/72	
	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	
N	ELEKTRONISCHER MULTIPLEXER (64 CHANNELS MAX +OR-10V, DATAWAY SET+INCR ADDRESS)	DO 200-1061	DORNIER	2	12/73	
N	(WITH FRONT PANEL CONNECTOR)	DO 200-1261		2	12/73	

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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	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	
N	PROGRAMMIERBARER VERSTAERKER/ABSCHWAECHER (ATTENUATION -60DB TO 0DB IN 6 STEPS, GAIN 0DB TO 60DB IN 6 STEPS, 2 CHANNELS)	DO 200-1053	DORNIER	1 NA	12/73	
	DIFFERENTIAL AMPLIFIER (GAIN CONTROLLED FROM DATAWAY)	CS 0014	NUCL. ENTERPRISES	2	/72	
	DUAL ATTENUATOR(50 OHMS,DATAWAY CONTROLLED,RANGE 0DB TO 31DB IN 1DB STEPS)	9004	NUCL. ENTERPRISES	1	/71	
	ATTENUATOR (0 DB TO 60 DB, MANUAL AND DATAWAY CONTROLLED)	J AT 10	SAIP/SCHLUMBERGER	3	/70	
	DIGITAL WINDOW DISCRIMINATOR (WITH 128X15BIT BUFFER, PARALLEL + SERIAL I/P)	DWD 2046	SEN	1	/72	(8)

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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	NUMERICAL CONTROL SYSTEM COMPRISING CASSETTE RECORER C 503, DATA WRITER AND DISPLAY C 504, AND TYPES	C 500	RDT	NA		
N	SERIAL CONTROLLER	C 502		0		
	DATA RECEIVER FOR MECHANICAL OPERATIONS (5 DECADE DATA,3 DECADE INSTRUCTION REG)	C 501		0		(7)

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

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

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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	EXECUTIVE SUITE ASSEMBLY OF MODULAR CONTROLLERS IN CAMAC CRATE, COVERS SYSTEM COMPLEXITY FROM SINGLE SOURCE-SINGLE CRATE TO MULTI SOURCE-MULTI CRATE SYSTEMS, COMPRISING		GEC-ELLIOTT			
	EXECUTIVE CONTROLLER (TRANSFORMS STANDARD CRATE INTO SYSTEM CRATE)	MX-CTR-2		2	/72	
	BRANCH COUPLER (ONE PER BRANCH, MAX 7)	BR-CPR-2		2	/72	
	AND SYSTEM INTERFACE SOURCE UNITS, ALSO OPTIONALLY AUTONOMOUS CONTROLLER SOURCE UNITS (ALL INSERTED INTO SYSTEM CRATE)		GEC-ELLIOTT			
	AUTONOMOUS CONTROLLER 1 (FOR MULTILEVEL AUTONOMOUS BLOCK TRANSFERS VIA DMA)	SC-ACU-1	GEC-ELLIOTT	1	06/73	
	PDP-11 SYSTEM INTERFACE, COMPRISING		GEC-ELLIOTT			
	PROGRAM TRANSFER INTERFACE	PTI-11 C/D		3	/72	
	UNIBUS TERMINATION UNIT	TRM-11		1	/72	
	SYSTEM INTERFACE BUS (LINKS UNIBUS TO ALL SI SOURCE UNITS FORMING INTERFACE)	SI-BUS-X11			/72	
	INTERRUPT VECTOR GENERATOR (ADDS AUTONOMOUS ENTRY OF GL-DERIVED INTERRUPTS)	IVG-11		1	/72	
	DIRECT MEMORY ACCESS INTERFACE (ADDS MULTICHANNEL DMA,NEEDS AUTONOMOUS CTRL)	DMA-11		1	06/73	
	NOVA/SUPERNOVA SYSTEM INTERFACE, COMPR		GEC-ELLIOTT			
	PROGRAM TRANSFER INTERFACE	PTI-N C/D		3	/72	
	I/O BUS TERMINATION UNIT	TRM-N		1	/72	
	SYSTEM INTERFACE BUS	SI-BUS-XN			/72	
	INTERRUPT VECTOR GENERATOR	IVG-N		1	04/73	
	INTERDATA 70-SERIES SYSTEM INTERFACE COMPRISING		GEC-ELLIOTT			
	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	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	SYSTEM CRATE TEST UNIT (TWO-COMMAND TEST UNIT FOR CHECKING SYSTEM CRATE SYSTEMS)	SC-TST-1	GEC-ELLIOTT	3	/72	
C	MICROPROGRAMMED BRANCH DRIVER FOR PDP-11 (WITH 256, 512, OR 1K WORDS OF MEMORY)	1201	BI RA SYSTEMS	NA	/72	(5)
	INTERFACE/SYSTEM CONTROLLER TO DEC PDP9 (PROGR, SEQUENT AND BLOCK TRANSFERS)	2202	BORER	NA	/71	(4)
	INTERFACE/SYSTEM CONTROLLER TO DEC PDP15 (PROGR, SEQUENT AND BLOCK TRANSFERS)	2203	BORER	NA	/71	(4)
	PDP-11 CAMAC CONTROLLER(SEQUENTIAL READ/WRITE,24 GRADED-L INTERRUPT DIRECTLY)	CA 11-A	D E C	NA	/71	(2)
	PDP-15 CAMAC INTERFACE(18/24BIT,PROGR, SEQUENT ADDR AND BLOCK TRANSFER MODES)	CA 15 A	D E C	NA	/71	(1)
	PDP-9 CAMAC INTERFACE (SOMEWHAT MODIFIED CA 15 A)	CA 15 A/PDP-9	D E C	NA	/71	
	PDP-11 INTERFACE/BRANCH DRIVER (24 VECTOR ADDRESSES, PROGRAMMED AND MULTIPLE DMA-TRANSFER, ADDRESS SCAN AND -LIST MODE, REPEAT-, LAM- AND STOP MODE)	CA 11-C	D E C	NA	/72	(4)
	PDP-11 BRANCH DRIVER (EUR 4600 COMPATIBLE,PROGRAMMED AND SEQUENT ADDR MODES)	BD-011	EG+G	NA	/71	
	PDP-11 BRANCH DRIVER	KS 0011	KINETIC SYSTEMS	NA	/71	(4)
	INTERFACE AND DRIVER FOR PDP 11 OR PDP 8 MULTI-CRATE SYSTEM, COMPRISING		NUCL. ENTERPRISES			
	BRANCH INTERFACE	9031		2	/72	(7)
	16-BIT CONTROLLER (WITH EITHER OF THE FOLLOWING INTERFACE CARDS)	9030		3	/72	(7)
	PDP 11 INTERFACE CARD	9032			/72	
	INTERFACE CARD FOR DEC PDP 8 SERIES	9034			04/73	(7)
C	INTERFACE CAMAC-PDP 11 (PROGRAMMED,BLOCK TRANSFER AND SEQUENTIAL ADDR MODES)	ICP 11/ICP 11 A	SAIP/SCHLUMBERGER	NA	/71	(4)
	PDP-11 SYSTEM CONTROLLER	C-CSC-11	WENZEL ELEKTRONIK	2	/72	
	NOVA BRANCH DRIVER	1251	BI RA SYSTEMS	NA	04/73	(5)
	INTERFACE/SYSTEM CONTROLLER TO HP2100, 2114, 2115, 2116	2201	BORER	NA	/71	(4)
	INTERFACE FOR VARIAN 620I/L/F COMPUTER (PROGR, SEQUENT AND BLOCK TRANSFERS)	2204	BORER	NA	/72	
N	SYSTEM CONTROLLER FOR SIEMENR 404/3 (TRANSFER OF 16 OR 24 BIT DATAWORDS PARALLEL BRANCH COMMAND CHAINING)	DO 200-2921	DORNIER	6	12/73	
N	(SAME BUT WITHOUT COMMAND CHAINING)	DO 200-2922		6	12/73	
N	SYSTEM CONTROLLER FOR SIEMENR 404/3 (TRANSFER OF 16 OR 24 BIT DATAWORDS PARALLEL BRANCH BUT NO COMMAND CHAINING)	DO 200-2923	DORNIER	6	12/73	
	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		(8)
	H316/DDP516 CAMAC BRANCH HIGHWAY DRIVER (MEETS EUR 4600 SPECS)		MICRO CONSULTANTS	NA		
N	INTERFACE-DRIVER FOR VARIAN 73/620I/620L MULTI-CRATE SYSTEM, COMPRISING		NUCL. ENTERPRISES			(8)
	BRANCH INTERFACE	9031		2	/72	(7)
	16-BIT CONTROLLER AND	9030		3	/72	(7)
N	INTERFACE CARD FOR VARIAN 73/620I/620L SERIES COMPUTERS	CS 0044				(8)
	INTERFACE FOR K202 COMPUTER	100	POLON	3	09/73	
N	INTERFACE CAMAC - T2000 A BASIC BRANCH CONTROL RACK	C COB 10	SAIP/SCHLUMBERGER	NA	/73	
N	CAMAC - T2000 BRANCH INTERFACE	T SC 20		NA	/73	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR

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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	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	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	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	(8)
	SINGLE CRATE SYSTEM CONTROLLERS(SEE EXECUTIVE SUITE, CLASS .211)		GEC-ELLIOTT			
	PDP-11-SERIES CRATE CONTROLLER	1304	BI RA SYSTEMS	2	02/73	
	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	
	INTERFACE AND DRIVER FOR PDP 11 OR PDP 8 SINGLE CRATE SYSTEM, COMPRISING		NUCL. ENTERPRISES			
	16-BIT CONTROLLER (WITH EITHER OF THE FOLLOWING INTERFACE CARDS)	9030		3	/72	(7)
	PDP 11 INTERFACE CARD	9032			/72	
	INTERFACE CARD FOR DEC PDP 8 SERIES	9034			04/73	(7)
	AUTONOMOUS CONTROLLER FOR PDP 11	9033	NUCL. ENTERPRISES	2	04/73	(8)
	CAMAC CRATE-PDP 11 INTERFACE	J CC 11	SAIP/SCHLUMBERGER	2		(7)
	CRATE INTERFACE FOR PDP 8/I	J CPDP 8/I	SAIP/SCHLUMBERGER	3	04/73	
	NOVA-SERIES CRATE CONTROLLER	1303	BI RA SYSTEMS	2	02/73	
	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	
N	CONTROLEUR DE CHASSIS MULTI 20 - CAMAC (24BIT,PROGR,SIMULT I/O,INTERRUPT MODES)	JCM 20	INTERTECHNIQUE	3	10/73	
N	INTERFACE CARD FOR VARIAN 73/620I/620L SERIES COMPUTERS	CS 0044	NUCL. ENTERPRISES			(8)
N	INTERFACE-DRIVER FOR VARIAN 73/620I/620L SINGLE CRATE SYSTEM,COMPRISING		NUCL. ENTERPRISES			(8)
	16-BIT CONTROLLER AND	9030		3	/72	(7)
C	CRATE INTERFACE FOR MULTI 8	J CM 8		3	/72	
	CRATE CONTROLLER 320	C 72451-A6-A1	SIEMENS	3	/72	
	CRATE CONTROLLER 404	C 76451-A7-A1	SIEMENS	0		

214 Controllers for Autonomously Operated Systems (and Related Units)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	DATENPROZESSOR (AUTONOMOUS PROGRAMABLE SINGLE DATAWAY CONTROLLER 16 REGISTERS	DO 200-2951	DORNIER	3	12/73	
N	(SAME WITH 32 REGISTERS)	DO 200-2952		3	12/73	
N	(SAME WITH 48 REGISTERS)	DO 200-2953		3	12/73	
N	(SAME WITH 64 REGISTERS)	DO 200-2954		3	12/73	
N	SPEICHER FUER DATENPROZESSOR (READ-ONLY MEMORY, 256 WORDS OF 16 BITS)	DO 200-2961	DORNIER	1	12/73	
N	(SAME BUT 512 WORDS OF 16 BITS)	DO 200-2962		1	12/73	
N	(SAME BUT 768 WORDS OF 16 BITS)	DO 200-2963		1	12/73	
N	(SAME BUT 1024 WORDS OF 16 BITS)	DO 200-2964		1	12/73	
N	SPEICHER FUER DATENPROZESSOR (RANDOM ACCESS MEMORY 1024 WORDS 16 BIT)	DO 200-2971	DORNIER	1	12/73	
N	(SAME BUT 2048 WORDS OF 16 BITS)	DO 200-2972		1	12/73	
N	(SAME BUT 3072 WORDS OF 16 BITS)	DO 200-2973		1	12/73	
	INDEPENDENT PROCESSER	130	POLON	3	10/73	

217 Other Parallel Mode Interfaces/Drivers/Controllers

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	SYSTEM 3000 CONTROLLER (FOR DISTRIBUTED INTERFACE SYSTEM, PARALLEL MODE)	1552	BORER	2	/72	

22 Interfaces/Controllers/Drivers for Serial Highway

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	SYSTEM 3000 CONTROLLER (FOR DISTRIBUTED INTERFACE SYSTEM, SERIAL MODE)	1551	BORER	2	/72	(7)
N	SERIAL EXTENSION UNIT, 8 BIT BYTE SERIAL LINK, BRANCH COMPATIBLE, CONSISTING OF		JOERGER		08/73	(8)
N	SERIAL DRIVER (TERMINATES BRANCH HIGHWAY AND RETRANSMITS COMMAND SERIALLY)	SD		2		
N	SERIAL RECEIVER (RECEIVES SERIAL DATA, DRIVES TYPE A-1 SYSTEM, OPTICAL ISOL)	SR		2		

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

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

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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	TYPE A-1 CRATE CONTROLLER	1301	BI RA SYSTEMS	2	02/73	
	CRATE CONTROLLER /ESONE TYPE A1/ (CONFORMS TO EUR4600 SPECS)	1502	BORER	2	/72	
N	CRATE CONTROLLER TYPE CCA-1 ACCORDING TO EUR4600 SPECS WITH CERN OPTIONS	DO 200-2905	DORNIER	2	03/74	
	CAMAC CRATE CONTROLLER TYPE A-1 (CONFORMS TO EUR4600 SPECIFICATIONS)	CC101	EG+G	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)
	BRANCH CRATE CONTROLLER/TYPE A-1 (CONFORMS TO EUR 4600 SPECS, 1972)	70A	JORWAY	2	02/73	(7)
	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	
	CRATE CONTROLLER TYPE A-1 (CONFORMS TO EUR4600 SPECS)	J CRC 51	SAIP/SCHLUMBERGER	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-A1	STND ENGINEERING	2	/72	(6)
C	TYPE A1 CONTROLLER WITH TERMINATOR (MEETS 4600 SPECS OF JAN 1972)	CCT-A1	STND ENGINEERING	2		
	CRATE CONTROLLER TYPE D (CONFORMS TO EUR 4100, USED WITH DO 280 COMPUTER SYSTEM)	DO 200-2901	DORNIER	2	/71	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR

232 Lam Graders

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	LAM GRADER (24 BIT MASK REGISTER, PLUG-IN PATCH BOARD, CERN 064)	LG 2401	GEC-ELLIOTT	1	/72	
C	LAM GRADER (INTERNALLY PATCHABLE, SWITCH SELECTABLE MULTI-CRATE BG-RESPONSE)	LG	JOERGER	1	05/73	(8)
	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, with Indicators)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	BRANCH HIGHWAY TERMINATOR	6601	BI RA SYSTEMS	1	03/73	
N	CC-11 TERMINATOR	6603	BI RA SYSTEMS	2		
N	BRANCH HIGHWAY TERMINATOR	6602	BI RA SYSTEMS	1		
	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	
	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	
	BRANCH TERMINATION WITH INTEGRAL CABLE	50C	JORWAY	2	/72	
	BRANCH TERMINATOR IN A CONNECTOR	BT-01	KINETIC SYSTEMS	NA	01/73	
	BRANCH TERMINATOR	J BT 20	SAIP/SCHLUMBERGER	2	/71	
	CRATE CONTROLLER BUS TERMINATOR FOR A-1 CRATE CONTROLLER	BT 2042	SEN	1	/72	
C	BRANCH HIGHWAY TERMINATOR	BHT-001	STND ENGINEERING	1	/73	
C	BRANCH HIGHWAY TERMINATOR, WITH DISPLAY	BHT-002/D	STND ENGINEERING	2	/73	
	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)

234 Branch Extenders, Bus Extenders

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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR

3 TEST EQUIPMENT

31 System Related Test Gear

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

311 Computer Simulators

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

32 Branch Related Testers/Controllers and Displays

321 Branch Testers/Controllers (Manual, Programmed)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	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)
	MANUAL BRANCH CONTROL SET (COMPRISING TYPES C COB 10 AND T CMB 10)	C CMB 10	SAIP/SCHLUMBERGER	NA	/71	(1)
	ADDRESS SCANNER (MANUAL CONTROL OF CRATE OPERATIONS)	C-AS-20	WENZEL ELEKTRONIK	2	/72	

33 Dataway Related Testers and Displays

331 Dataway Controllers/Testers (Manual, Programmed)

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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR

332 Dataway Displays

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	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)
	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)
C	DATAWAY DISPLAY MODULE	DD-002	STNC ENGINEERING	1	/72	(5)
	DATAWAY DISPLAY	C-01-24	WENZEL ELEKTRONIK	1	/72	
	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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	CAMAC EXTENDER MODULE	8201	BI RA SYSTEMS	0		
	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	
	EXTENDER CARD	1100	KINETIC SYSTEMS	1	/71	(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	
C	EXTENDER (XXX=LENGTH OF CABLE IN MM BEYOND RACK, SINGLE WIDTH)	577/XXX	TEKDATA	1	/72	(5)
N	EXTENDER (XXX=LENGTH OF CABLE IN MM BEYOND RACK, DOUBLE WIDTH)	5813/XXX		2	03/73	
	PROLONGATEUR POUR TIROIRS CAMAC (EXTENDER)		TRANSRACK	1	/70	

37 Other Test Gear for CAMAC Equipment

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	TRANSIENT GENERATOR(MODULE NOISE SUSCEPTIBILITY TESTED BY TRANSIENTS ON DC LINES	TG	JOERGER	1	08/73	

4 CRATES, SUPPLIES, COMPONENTS, ACCESSORIES

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

411 Crates with Dataway and Supply

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	CRATE (270 VA,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 RECOMMENDED 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)
N	POWERED CRATE	1500	KINETIC SYSTEMS	NA	/73	
	POWER CRATE (7005-2 CRATE WITH 9022 POWER SUPPLY)	9023	NUCL. ENTERPRISES	24	/71	(2)
N	POWERED CRATE (+AND-6V/25A, +AND-24V/6A, (INCL POWER DESIGN TYPE AEC432 SUPPLY)	NSI-875CC100AEC432	NUCL. SPECIALTIES	25		
	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	
N	POWERED VENTILATED CRATE (+6V/24A, -6V/16A, +AND-24V/3A, MAX 400W)	C JAL 41	SAIP/SCHLUMBERGER	25	/73	(8)
	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)

412 Crates with Dataway, without Supply

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	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		25	/72	
	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		
	UNPOWERED CRATE WITH DATAWAY AND CONNECTORS	UPC 2029	SEN	25	/70	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	CRATE (WIRED CRATE)	WCS	STND ENGINEERING	25		(5)

413 Crates without Dataway, with Supply

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	CAMAC COMPATIBLE CRATE (WIRED)	NSI-875 DB-HV	NUCL. SPECIALTIES	25		
N	CAMAC CRATE	NSI-875 CC 100	NUCL. SPECIALTIES	25		

417 Blank Crates and Other Components and Accessories

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	CRATE WITH F.P.C. POWER RAIL ASSEMBLY	TYPES 3,4,7,8	MB METALS		/72	
	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/HV	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)
N	CAMAC CRATE (EMPTY) HEAVY DUTY		WILLSHER + QUICK		/73	
N	6U WITH VENTILATION BAFFLE	9905-5HV		25	/73	
N	5U NON VENTILATED DEPTH OPTIONS 360MM, 460MM, 525MM	9905-5H		25	/73	
	1U COOLING DRAWER (FOR CRATE ONLY, 2 FANS, FITS 6U CRATE)	CDR 1	GEC-ELLIOTT		/72	
	2U COOLING DRAWER (COOLS CRATE AND CRATE MOUNTED PS 0003,FAN+CONTROL PANEL INCL)	CDR 2	GEC-ELLIOTT		/72	
	VENTILATION UNIT	CAM/FV	IMHOF-BEDCO		01/73	
	LUFTEREINHEIT (VENTILATION UNIT,COMPLETE WITH 3 FANS AND FILTER)	2.081.000.6	KNUERR		/70	
	(VENTILATION UNIT,NO FAN,NO FILTER)	2.085.000.6				
	FAN UNIT (FOR ALB/10 SUPPLY SYSTEM)	VALB/10	SAPHYMO-SRAT		/72	
	CRATE BLOWER UNIT		STND ENGINEERING			(5)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	VENTILATION UNIT	1UVCAM	WILLSHER + QUICK		/71	(3)
	1U VENTILATION GRILL	1 UG	WILLSHER + QUICK		/72	

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

421 Multi-Crate Supplies

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	POWER SUPPLY FLEXIBLE	CPU/1	GRENSON		/71	
	SYSTEM COMPRISING					
	BASIC CRATE(FOR SUPPLY MODULES,INCLUDES	CFC				
	REFERENCE,CONTROL AND 200V/0.1A)					
	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)	C4 BIP 203	SAPHYMO-SRAT		/72	
	(MODULE OPTIONS AS FOLLOWS)					
	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	ALB/10	SAPHYMO-SRAT		12/73	(2)
	(RAW SUPPLY FOR REGULATOR MODULES)					
	FAN UNIT	VALB/10				
	WIRED RACK 42 U	BC 42				
	POWER SUPPLY MODULE 6 V 5 A(REGULATOR)	BPR 605				
	6 V 10 A	BPR 610				
	6 V 25 A	BPR 625				
	12 V 2 A	BPR 122				
	12 V 5 A	BPR 125				
	24 V 3 A	BPR 243				
	24 V 5 A	BPR 245				

422 Single-Crate Supplies

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	COMPACT POWER SUPPLY UNIT (CRATE/PANEL	PS 0003	GEC-ELLIOTT		/71	
	MOUNT,+AND-6V/25A,+AND-24V/6A,200/300W)					
	CAMAC POWER UNIT (+6V/15A,-6V/3A,+24V/2A	CPU/4	GRENSON			
	-24V/2A,200V/0.05A,117VAC)					
	CAMAC POWER SUPPLY	CPU/2	GRENSON		/71	
	(+6V/20A,-6V/5A,+AND-24V/5A,200V/0.05A)					
	SAME WITH SWITCHED METERING	CPU/2M			/71	
	POWER SUPPLY (+6V/20A,-6V/5A,	CPU/5	GRENSON		/71	
	+AND-12V/2A,+AND-24V/3A)					
	POWER SUPPLY (RACK MOUNTING,+6V/25A,	CPU/6	GRENSON		/71	
	-6V/15A,+AND-24V/5A,200V/0.1A)					
	POWER SUPPLY (RACK MOUNTING,+6V/25A,	CPU/7	GRENSON		/71	
	-6V/15A,+AND-24V/5A,+AND-12V)					
	POWER SUPPLY (+6V/20A,-6V/5A,	9001	NUCL. ENTERPRISES		/71	
	+AND-24V/5A,200V/0.05A)					
	POWER UNIT (+6V/15A,-6V/3A,	9022	NUCL. ENTERPRISES		/71	(2)
	+AND-24V/2A,200V/0.05A)					
	POWER SUPPLY (+6V/15A,-6V/4A,+AND-24V/2A	CZC-10	POLON		06/73	
	+200V/0.05A NONSTABILISED, MAX 300W)					
	POWER UNIT (+6V/20A, -6V/15A,+24V/2A,	SP 426	POWER ELECTRONICS			
	-24V/2A,200V/0.1A)					
	POWER SUPPLY (+6V/25A,-6V/5A,	C 303	RDT		/71	
	+AND-12V/2A,+AND-24V/3A,200V/0.1A)					
	POWER UNIT(FOR SUPPLY MODULES)		RO ASSOCIATES		/71	
	CAMAC SYSTEM POWER SUPPLY MODULE	C 301			/70	
	(+AND-12V/72W, OR +12V/6A OR +24V/3A)					
	(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	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	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)
€	POWER SUPPLY (+AND-6V/6A SHARED AND +AND-24V/2A SHARED, METERING OF V AND I)	825	STND ENGINEERING			

427 Blank Supply Chassis, Other Components/Accessories

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	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	
	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	
N	POWER INDICATOR	0704	NUCL. ENTERPRISES	NA	/70	

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

431 Branch Related (Cables, Connectors etc.)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	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	
	BRANCH HIGHWAY CABLE ASSEMBLY (WITH CONNECTORS,27 CM LONG)	CC 66 POL PB-27	EMIHUS		/71	
	(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	
N	BRANCH HIGHWAY CABLE		JOERGER			
	BRANCH CABLE WITH CONNECTOR (1.5 FT TO 75 FT LONG)		JORWAY		/71	
	BRANCH HIGHWAY CABLE (66 TWISTED PAIRS)	CL 90	SAIP/SCHLUMBERGER		/71	
	BRANCH HIGHWAY CABLE ASSEMBLY (COMPLETE WITH CONNECTORS, LENGTH 27 CM)	BHC 27	SEMRA-BENNEY		/72	
	(SAME, XXX=LENGTH IN CM, 040,100 ETC)	BHC XXX			/72	
	BRANCH HIGHWAY CABLES(COMPLETE WITH CONNECTOR,XXX = LENGTH IN METERS)	2000/S/0132/XXX	TEKDATA		/71	(4)
	BRANCH HIGHWAY CONNECTOR (FIXED MEMBER,SOCKET MOULDING)	WSS0132S00BN000	EMIHUS		/70	
	(FREE MEMBER,PIN MOULDING, PXX YYY SELECTS JACKSCREW)	WSS0132PXXBNYYY				
	HOOD (FOR FREE MEMBER)	WAC 0132 H005				
	BRANCH HIGHWAY CABLE ONLY (PLAIN PVC JACKET)	66 POL PB	EMIHUS		/71	
	EXTENDED BRANCH CABLE (LOW COST TELE- PHONE CABLE FOR LONG BRANCH RUNS)	EBC XXXX	GEC-ELLIOTT		/72	
	BRANCH HIGHWAY CABLE (132-WAY)	LIY-Y72X2X0.088	LEONISCHE		/72	
N	BRANCH HIGHWAY CABLE (TRUE 132-WAY WITH METALISED POLYESTER SCREEN, PVC JACKET)	LI2Y(ST)Y66X2X0.18	LEONISCHE			
	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	
	CABLE EXTENSION MODULE (JOINS TWO BRANCH HIGHWAY CABLES)	CD 18106	EMIHUS		/72	

NC	DESIGNATION + SHORT DATA	* TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	BRANCH HIGHWAY TO PDP-11 (COMPLETE WITH CONNECTORS, XXX= LENGTH IN METERS)	5805/P/0132/XXX	TEKDATA		07/73	(8)

432 Dataway Related (Connectors, Boards, Assemblies)

NC	DESIGNATION + SHORT DATA	* TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
C	DATAWAY MOTHERBOARD (MULTILAYER PNB)	DM-1	STNO ENGINEERING			
	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	
	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	
	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				
C	CAMAC DATAWAY CONNECTOR (* INSERT A FOR SOLDER TAG, B SOLDER PIN, C MINI WRAP)	G03D 086P 2B * BL	ITT CANNON			(6)
	CAMAC-LEISTE(DATAWAY CONNECTOR,WIREWRAP)	4.000.000.0	KNUERR		/70	
C	DATAWAY FEMALE CONNECTOR, MINI-WRAP	2422 061 64334	PHILIPS		/71	(5)
	BOARD SOLDER	2422 061 64354				(5)
	WIRE SOLDER	2422 061 64314				(5)
C	DATAWAY MALE CONNECTOR (MATING THE CRATE MOUNTED 86-WAY CONNECTOR SOCKET)	2422 060 14314	PHILIPS		/72	(5)
	CONNECTEUR 254 DOUBLE FACE (DATAWAY CONNECTOR,WIRE WRAP)	254 DF 43 AWV	SOCAPEX		/70	
	(MOTHERBOARD SOLDER)	254 DF 43 AYV			/70	
	(WIRE SOLDER)	254 DF 43 AZV			/70	
	DATAWAY CONNECTOR (MINI-WRAP)	8606 86 21 15 000	SOURIAU		/71	
	(WIRE-SOLDER)	8606 86 21 10 000				
	(FLOW SOLDER)	8606 86 21 14 000				
	DATAWAY CONNECTOR (*=2 FLOW SOLDER,*=3 SOLDER LUGS,*=4 MINIWRAP,AU PLATING)	C 288* CSP 221	UECL		/71	
	(FLOW SOLDER,NI + AU PLATING)	C 2885 CSP 221				
	(13 MINIWRAP CONTACTS,OTHER ARE FLOW SOLDER,NI + AU PLATING)	C 2886 CSP 221				
	(*=7 MINIWRAP,*=8 SOLDER LUGS, NI + AU PLATING)	C 288* CSP 221				
	MOUNTING BRACKETS FOR ABOVE	C 8523				

433 Module Related (Blank Modules, Patchboards etc.)

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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	MODULE KIT (EMPTY MODULE,1 UNIT WIDTH)	9005-1	NUCL. ENTERPRISES	1	/71	
	(EMPTY MODULE,2 UNIT WIDTH)	9005-2		2	/71	
	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)
N	CAMAC MODULE,SHIELDED (EMPTY, 1 WIDTH)	NSI-875-DM/SPH-1	NUCL. SPECIALTIES	1		
N	(SAME, *=2, 3, AND 4 FOR CORRESP WIDTH)	NSI-875-DM/SPH-*	NUCL. SPECIALTIES			
	TIROIR MODULAIRE (W=1/25)	9905-1-L	DSL	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	DSL	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		
	EMPTY MODULE SCREENED (1 WIDE, ADD TYPE SUFFIX A FOR SHORT, B FOR LONG SCREENS)	CM1	SEMRA-BENNEY	1	02/73	
	(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)
N	EMTY MODULE WITH HINGED CARDS (2/25)	9905-CB2	DSL/WILLSHER+QUICK	2	/73	
N	(3/25)	9905-CB3		3	/73	
N	EMPTY MODULE (1/25)	9905-5T1	DSL/WILLSHER+QUICK	1	/73	
N	(**= T2, T3, T4, T5, T6, T8, T10, AND T12 FOR CORRESPONDING WIDTH)	9905-5**			/73	
	TIROIR MODULAIRE POUR COMMANDE	9905-TC-1	DSL	1	/71	
	TIROIR MODULAIRE DE COMMANDE (SUPPLY CONTROL MODULE)	TCM 525	TRANSRACK	1	/70	
	MATRIX BOARD (DOUBLE SIDED, FOR PROTO-TYPE WIRING OF 14,16,24 AND 40 PIN DIL)	EB5/1159	NUCL. ENTERPRISES			
	DECODED MATRIX BOARD (FOR PROTOTYPE WIRING, 64 14-PIN SITES,A AND F DECODED)	D20654				
N	BLANK CAMAC MODULE PRINTED CIRCUIT BOARD (GOLD PLATED BOTH SIDES, UNETCHED)	NSI-04071-PC	NUCL. SPECIALTIES	NA		
	CARTE CIRCUIT IMPRIME CAMAC (PRINTED CIRCUIT BOARD FOR CAMAC MODULE)		TRANSRACK	NA	/70	
	MK-1 KLUGE MODULE (131 MIXED 14, 16, 24 PIN SOCKETS)	8301	BI RA SYSTEMS	2	01/73	
N	MK-5 KLUGE MODULE (HAS 70 14 PIN, 13 AND 2 24 PIN WIRE WRAP SOCKETS)	8305		2		
	CAMAC-UNIVERSALKARTE (PRINTED CARD MODULE WITH 28 14-PIN + 28 16-PIN SOCKETS)	DO 200-2900	DORNIER	2	/71	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	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	
C	KLUGE CARD (FOR CREATING YOUR OWN CAMAC MODULES)	2000-36	KINETIC SYSTEMS	1	/71	(4)
N	KLUGE CARD	2000		1	/73	
	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 0V AND +6V)	CBP 2		NA	/72	
	BLANK MODULE(COMPLETE WITH PRINTED BOARD FOR 69 INTEGRATED CIRCUITS,1 U WIDTH)	BM 2020/1U	SEN	1	/70	
	(SAME,2U WIDTH)	BM 2020/2U		2	/70	
	EXPERIMENT PLATE	C 72468-A453-A1	SIEMENS	0		

437 Other Recommended or Standard Components/Access.

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	NIM ADAPTOR	7009-2	NUCL. ENTERPRISES	NA	/70	
	NIM-CAMAC ADAPTOR	CAN	RDT	NA	/71	
	NIM/CAMAC ADAPTOR	ANC 10	SAIP/SCHLUMBERGER		/72	
	CAMAC NIM ADAPTOR	CNA 2033	SEN	2	/71	
	LAM GRADER CABLE (20CM, WITH CONNECTORS)	LGC 20	GEC-ELLIOTT		/72	
	(40CM, WITH CONNECTORS)	LGC 40			/72	
N	LAM GRADER CABLE		JOERGER			
N	52 WAY CANNON 2DB52S HARNESSES LAM GRADER CABLE, XXX= LENGTH IN METERS)	5809/S052/XXX	TEKDATA		08/73	
	52-WAY DOUBLE DENSITY CONNECTOR (FIXED MEMBER WITH PINS.LAM GRADER CONNECTOR)	2 DB 52 P	ITT CANNON		/70	
	COAXIAL CONNECTOR	RA 00 C50	LEMO		/70	(4)

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

Benney—See Semra-Benney

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

Berthold/Frieseke – See BF Vertrieb

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

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

C Cannon Electric GmbH
Bureau Schweitz
Brandschenkenstrasse 178
CH-802' Zurich, Switzerland

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

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

Digital Equipment Corporation SA
81, Route de l'Air
CH-122' Carouge-Genève, Switzerl.

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

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

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

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

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

C O.S.L.
18bis, Avenue du Général De Gaulle
F-06340 La Trinité, France

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

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

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

Polon – See Zjednoczone

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

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

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

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

SABCA – See Emihus, Belgian Branch

Saip/Schlumberger
B. P. 47
F-92222 Bagneux, France

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

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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

Souriau et C[ie]
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F-92 Boulogne-Billancourt, France

C Standard Engineering Corp.
44800 Industrial drive,
Fremont, California 94538, USA

Tech and Tel – See Technograph

C Techcal - See Stnd Engineering

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

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

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

Wenzel Elektronik
Lamontstrasse 32
D-8000 München 80, Germany

Wenzel Electronik (UK) Ltd.
Arndale House, The precinct
Egham, Surrey, England

Willsher and Quick Ltd.
Walrow
Highbridge, Somerset, England

Willsher and Quick GmbH
Steylerstrasse 27, Postfach 2192
D-4054 Nettetal 2, Germany

Zjednoczone Zaklady Urzadzen
Jadrowych Polon, Biuro Zbytu
Pl-00-086 Warszawa,
Bielanska 1, Poland

4

DERANDOMIZING CAMAC INPUT MODULE

by

R. Klesse

Institut Max von Laue — Paul Langevin, Grenoble, France

Received 22nd January 1973

SUMMARY   This CAMAC module is a last-in first-out buffer that can accept randomly-timed data words and transfer them via the Dataway to a computer. It is used when the transfer rate to the computer is not sufficient for the peak data rate, but can handle the mean rate.

The module described in this paper accepts and buffers a random or bunched sequence of data from an external source and transfers them via the CAMAC Dataway into the computer. The buffering of the data is necessary if the transfer rate to the computer is not sufficient for resolving successive events. The average frequency of occurrence of the data must not exceed the transfer rate of the computer channel. The module has been used for neutron time-of-flight measurements. A schematic design of the module is shown in Fig. 1.

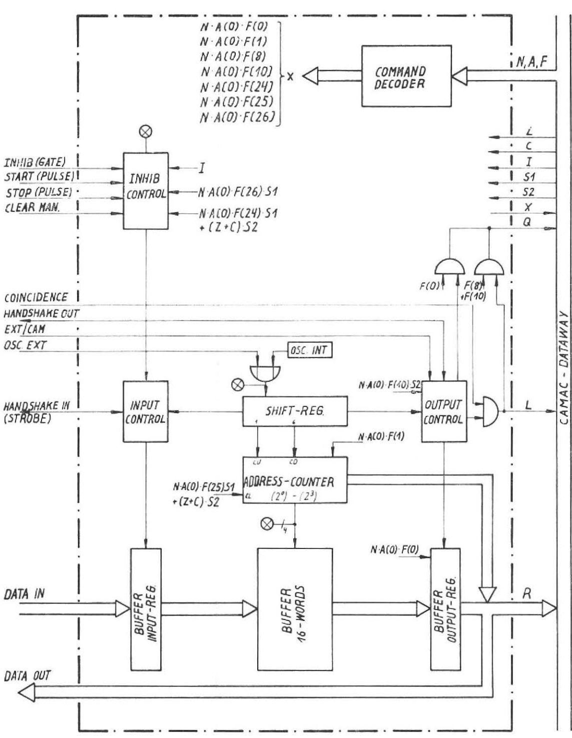

Fig. 1   Block Diagram of Derandomizing Input Module

The data enter the double width module by a 52-pin Cannon-connector. The data-input gate is controlled by:

a) Computer command: Enable-Disable;
b) CAMAC Inhibit signal I;
c) External gate-signal (inhibition);
d) External 'start-stop' pulses.

The transfer into the module may be strobed or 'handshake' controlled. The capacity of the 'Last in first out stack' memory is 16 words of 24 bits. The information can be read out either by a read commend via the Dataway or by a handshake-controlled transfer via a second 52-pin Cannon-connector at the frontpanel. During the read operation via the Dataway, the information is also available at the front panel output-connector (for test equipment such as a multichannel analyser).

A LAM is generated if there are one or more words in the buffer. By a slight modification it is possible to set the LAM when a larger number of words (8 or 16 for example) are buffered. In this way Q-scan read-out operations can be performed.

Several modules of this type can be connected together for parallel or serial operation.

In the parallel operation mode for multi-parametric measurements the LAM of several modules can be gated by a rear panel input to provide the desired coincidence condition.

In the serial operation mode a buffer overflow signal can be utilized to start a following Derandomizing CAMAC Input Module which is connected to the same source. This can be useful in the case of pulsed data-sources or in the case of intermittent data transfer to the computer.

The overflow signal is maintained to indicate 'no access possible to the module'. This signal can be used to measure the dead-time of the data-transmission system.

NEWS

ANNOUNCEMENTS BY CAMAC MANUFACTURERS

STANDARD ENGINEERING CORPORATION, Fremont, California, USA, is now the sole manufacturer of all CAMAC products formerly designed and manufactured by Techcal Electronics Services, Vancouver, B.C., Canada. This allows Standard Engineering to deliver a complete line of CAMAC products including, crates, power supplies, hardware, instrumentation and small systems complete with CPU.

NEWS

CAMAC AT THE IMEKO CONGRESS

The sixth Congress of the Internationale Meßtechnische Konföderation (IMEKO) was held from 17th to 23rd June 1973 in Dresden, German Democratic Republic. Major topics of the very successful and excellently organized conference were theory, testing, calibration and application of measuring systems and industrial sensors, as well as on-line measurements in processes. A special section was dedicated to "Means and Methods for Instrument-Computer Interfaces". The survey paper of this section was given by T. I. Williams, Purdue University, Indiana, dealing with the problems of on-line computer applications in industrial processes. The importance of standardized hardware and software for industrial computer systems was emphasized in order "to avoid wastage of the intellectual input to systems development". The CAMAC instrumentation system was given as an excellent example of a working standard used internationally. The activity of the Purdue Workshop on standardization of industrial computer languages was described in some detail.

A round table discussion on "Problems and Techniques in data acquisition systems" again drew the attention of many people attending the conference to the CAMAC system. This was backed up by a report from E. Kingham of the Central Electricity Research Laboratories (CERL), Leatherhead, UK on his positive experience with CAMAC instrumentation in data logging and process control.

As one of the section papers, H. Klessmann from the Hahn-Meitner-Institut Berlin presented an introduction to the CAMAC system and pointed out the current work of the ESONE Committee in cooperation with the United States AEC NIM Committee on the Serial Highway and the IML programming language.

The major attendance at this international conference was from the German Democratic Republic and eastern countries. They showed a great interest in CAMAC, and arrangements were made to deal with many requests for information. From private discussions it was apparent that CAMAC instrumentation is already used or about to be used in some universities and research installations in these countries, including applications in nonnuclear areas. However, for those interested in industrial applications of CAMAC there is a lack of convincing working examples and references—the activity of the Aluminium Corporation of America (ALCOA) was received with great interest. Furthermore the lack of information on software support of CAMAC systems still seems to be a major problem.

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, lightly in pencil on the back of each illustration. A list of all figure numbers and captions should be included on a separate sheet, even if these are given in the text or on the illustrations themselves.*
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.*
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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.*

SOFTWARE

SOME ASPECTS OF A COMPILER WRITING SYSTEM AND THE IMPLEMENTATION OF THE CAMAC LANGUAGE

by

K. H. Degenhardt, U. Marx-Rehbein and W. Woletz

Hahn-Meitner-Institut für Kernforschung Berlin GmbH, Berlin, Germany

Received 27th June 1973

SUMMARY Recent work at the Hahn-Meitner-Institut to automate the writing of compilers for programming languages is presented. The first application of the Compiler Writing System (CWS) will be the implementation of a compiler for the CAMAC language.

INTRODUCTION

The purpose of a compiler writing system (CWS) is to simplify the implementation of compilers. The main components of a CWS are:

- a language for describing the syntax of a programming language;
- a semantic language, i.e. a language in which semantic routines are written.

The term compiler-compiler (CC) is often used because a CWS compiles other compilers.

A CWS[1] works as follows:

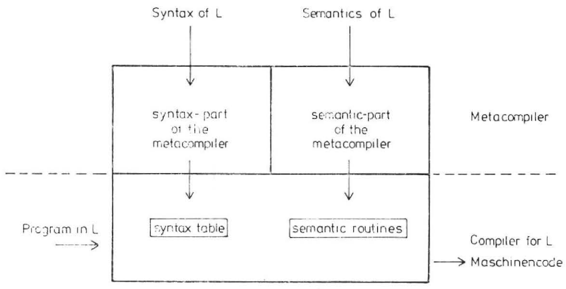

Fig. 1 A Compiler Writing System

Suppose a compiler for some language L, e.g. the CAMAC language[2], is required. The input to the CWS consists of the formal syntax of L written in a metalanguage and a set of semantic routines (semantic metalanguage). The CWS compiles the syntax and the semantics of L into two tables. The syntax table is used by a standard parsing routine to perform the recognition and parsing of programs written in L. The information contained in the semantic table describes the meaning of statements in L. Semantic routines are associated with syntactic constructs. These routines are executed when syntactic constructs are recognized. Generally a compiler for some language L generated as described above will be less efficient in memory and compile time than a compiler written in assembly language. The reasons for using a CWS for the construction of compilers are similar to those for using high-level languages for programming.

AUTOMATICALLY CONSTRUCTED RECOGNIZER

Weak precedence

Generally the notation (metalanguage) used for describing the syntax of programming languages is the Backus-Naur-Form (BNF) or some extension of it. The syntax of a language L can be defined by a set of rules (productions) written in BNF. The symbols (reserved words, delimiters, identifiers, etc.) used in these rules form the alphabet of L.

There are three types of precedence relations $<\cdot$, $\cdot>$ and $\doteq$ between the symbols of a syntax. A language L is a precedence language if at most one relation holds between any pair of symbols and if no two productions of the syntax have identical right parts. A precedence recognizer uses these relations to decide whether to scan a new symbol or to do a reduction and, if so, which reduction. Practically, most programming languages are not precedence languages. Problems arise because very often more than one relation holds between two symbols. Identical right sides are also familiar in programming languages. These conflicts are due to the fact that a precedence parser uses very little context in making decisions (it only uses two adjacent symbols). In order to decrease the number of conflicts, the concept of precedence has been generalized to that of weak precedence[4]. There are only two weak precedence relations, $\leqq\cdot$ and $\cdot>$; and the decision which reduction should be performed depends on pattern matching. The concept of weak precedence does not solve all problems, because most programming languages are not weak precedence languages.

Production language

The weak precedence relations can be derived automatically from a weak precedence syntax. Usually the relations are stored in matrix form or in some kind of list. A weak precedence parser using a matrix is expensive in core memory, if it uses a list it is expensive in time. Ichbiah and Morse[4] have developed an algorithm for automatic translation from a weak precedence matrix to an 'almost optimal' program written in production language (PL)[5,6]. By this process, which is performed at metacompiletime, the information contained in the matrix could be stored in a very compact manner. The production language is a metalanguage for writing recognizers. A recognizer written in PL consists of a set of productions of the form

$$\text{L1} \quad S_3S_2S_1 \rightarrow S_2{}'S_1{}' \quad {*}\text{L2} \qquad (1).$$

The productions specify actions to be performed on symbols of a stack. Production (1) reads as follows: compare S_1, S_2 and S_3 with the top of the stack. If there is a match, the matched symbols S_1, S_2, S_3 in the stack are replaced by the symbols S_1', S_2'. If they do not match the next production in the PL-program is tried. '*' indicates that the next input symbol is scanned and pushed onto the stack. After successful execution of (1) the production labelled L2 is executed. In practice the PL-program is transformed into tables on which a standard parser acts.

The syntax part of a metacompiler

As already mentioned, most programming languages (e.g. ALGOL 60, CAMAC language) are not weak precedence languages because the weak precedence concept uses very little context. The symbols and their relations are used without regard to the environment of the symbols. We have developed a method of changing a given syntax in order to solve these problems. An important feature of this method is that it does not change the structure of a syntax. The syntax part of our CWS is a program written in FORTRAN and IBM360-Assembly. It accepts a syntax written in BNF, transforms it, constructs the weak precedence matrix and translates the matrix into a PL-program which is finally transformed into tables. The standard parser which acts on these tables is rather simple and can easily be written in some language convenient for the available computer.

The syntax tables generated for the CAMAC language need 8K bytes (one pass compilation without segmentation). The tables are generated in 5 min on a SIEMENS4004-55. The program has been successfully tested with other languages, e.g. ALGOL 60.

SEMANTICS

As mentioned, one of the components of a compiler-compiler is a semantic metalanguage which permits the description of the source language (e.g. CAMAC language).

Each PL-Statement in the syntax language may include a command which is a jump to a semantic statement. This semantic statement will be executed each time that production (PL statement) is matched[7].

The actions to be performed by a semantic statement are the following:

- Checking the semantic correctness (e.g. whether an identifier is a CAMAC c-name or not);
- Generating code (In the case of the CAMAC language IML-statements (Macros) are generated);
- Changing the state of the translator (e.g. if a CAMAC equivalence statement is matched).

The semantic part of the CWS is a program written in FORTRAN and IBM360-Assembly. It accepts semantics written in the metalanguage and translates them into semantic routines.

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NEWS

CAMAC IN WARSAW

Dr. Roman Trechcinski reports that an International Symposium and Exhibition on Nuclear Electronics was held in Warsaw from 5th-10th April 1973. Nine papers dealing with CAMAC systems were presented and four of them were concerned with the Vector System, which is similar to CAMAC and developed in the USSR.

CAMAC systems were demonstrated by laboratories in Czechoslakia, Hungary, Roumania and Poland and two complete measuring systems working with computers type K202 (Poland) and 1001-TPAI (Hungary) were also exhibited. Laboratories from the USSR demonstrated instruments that were compatible with the Vector System.

Both the papers and the demonstrations aroused a great deal of interest from those attending the symposium.

IDEAS AND TECHNIQUES

1 PROPOSAL FOR A POWER FAILURE SIGNAL FROM THE CAMAC POWER SUPPLY TO THE CONTROL STATION

by

C. Eck*, F. Iselin and J.-P. Vanuxem

NP Division, CERN, Geneva, Switzerland

* Institut für Physik, Universität Mainz, Germany

Received 14th May 1973

SUMMARY A Power Failure feature is recommended to provide the controller with an early warning signal that the mains supply has failed. This allows action to be taken to save the contents of registers in the CAMAC crate while the d.c. supply voltages are still within tolerances.

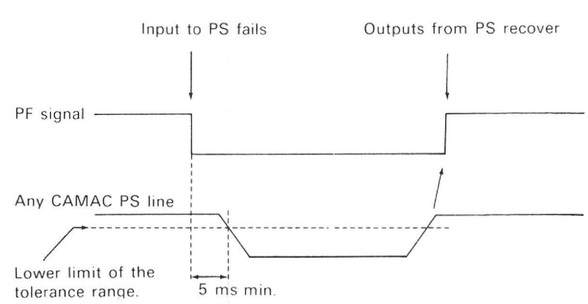
INTRODUCTION

In most CAMAC systems data integrity is of prime importance, and therefore it should be possible to save the contents of all CAMAC registers in case of a power loss in the crate. This proposal describes the use of a single additional signal, the PF signal, to initiate this saving procedure. In CAMAC systems with dedicated crate controllers it is also possible to restore the contents of these registers automatically when power comes up again.

DEFINITION OF THE PF SIGNAL

The PF signal is an anticipatory TTL-level signal derived, for example, from failure of the mains input to the power supply. After PF has been asserted (low level) there must be at least 5 ms before any output voltage on the power supply lines (measured on the Dataway) goes below its tolerance range, as defined in table X of EUR 4100e (1972), under full load conditions. This figure of 5 ms is small enough to deal with most existing CAMAC power supplies, which could then easily be modified to provide the PF signal, and large enough to guarantee that, for most CAMAC systems, the controller (or computer) has time to save all relevant data contained in the CAMAC crate when a power failure occurs.

When the voltages on all output power supply lines come up again within their tolerances, the PF signal is negated. Care should be taken to avoid 'hunting' problems.



It is proposed that the PF line, coming from the power supply block of the crate, goes to pin L24 of the control station connector.

Currents and voltages on this line must be those of a normal L-line, see tables V and VII of EUR 4100, even if this particular L is transferred without a LAM status register.

TRANSFER OF THE PF INFORMATION TO THE SYSTEM CONTROLLER

Depending on whether the crate controller is a Crate Controller Type A or whether it is dedicated to a specific computer, and in this latter case depending also on the type of computer used, different ways of transmitting the PF information are suggested.

Crate Controller Type A The PF contact (L24 at the control station) could simply be wired to any GL-line inside the crate controller, but preferably to GL24 (indicating that the PF-signal has top priority). In Crate Controllers Type A-1, conforming to Appendix 1 of EUR 4600e, a pull-up is provided on the GL24 line, but an internal connection from L24 to GL24 is not specified. No automatic power-up procedure is possible.

Dedicated crate controller (specific to a defined computer) The PF signal could generate an interrupt to the computer in a way similar to CCA. In some applications where the computer has a special power failure line (as in the case of the PDP-11), there can be a simple connection of L24 to this line, and the computer will trap to a power failure subroutine as soon as the signal is asserted. In such applications, there can also be circuitry so that negating the PF signal starts an automatic power-up procedure to restore the values which were in the CAMAC registers before the power failure occurred.

CONCLUSION

The PF signal offers much better system reliability to CAMAC users. It is felt that the effort to make the PF line available is small compared with the advantages that it can provide.

2

MODULE DESCRIPTOR

by

O. Ph. Nicolaysen

CERN, NP Division, Electronics Development II, Geneva, Switzerland

Received March 1973, revised form July 1973

SUMMARY The revised CAMAC specification recommends an address for accessing a module descriptor word, but does not define the contents of the descriptor. This paper reviews the sources of information about the characteristics of a CAMAC module, and proposes a 16-bit descriptor word.

SOME GENERAL REFLECTIONS

The Module Descriptor introduced by CERN (named RMC = Read Module Characteristic), has assigned bit-fields for the CERN type number of the module and the number of registers. The RMC is addressed by F(6)·A(x), and is included on all commercially produced modules based on CERN designs. It has not otherwise gained widespread use, possibly because it does not provide information that is sufficiently universal or directly useful for software interpretation.

When the new command N·F(1)·A(15) was assigned to the Module Descriptor in EUR 4100e (1972) very few manufacturers started to use it. No guide on its usage was given, no standard significance was defined, and there was always the possibility of later changes. To include the Module Descriptor costs money; leaving it out means at least lower module prices or better economy for manufacturers, arguments not to be neglected.

MODULE CHARACTERISTICS IN SYSTEM APPLICATIONS

The Module Descriptor should provide information about characteristics pertinent to system operation (Dataway signals, commands, data formats, etc.). Information about characteristics related to external connections to the module are less important in this context (input or output levels, accuracy, speed of operation, connectors used, etc.). Usually in setting up a system one needs anyhow to know interconnection characteristics at the time of selecting the modules.

X and Q: Sources of information about Module Characteristics

Much information about a module can be obtained simply by addressing the module with all combinations of F and A and watching the Q-response. Modules designed and/or produced after August 1972 should also give a signal on the X line for all commands accepted.

This provides the following information immediately

- The number of registers for each function $F(y)$ [addressed by $A(x)_{x=0\rightarrow} \cdot F(y)_{y=0\rightarrow}$].
- If LAM is used, and possibly how many L sources [F(1)·A(12 to 14), F(8), F(10), F(11), etc.].
- If non-standard functions are used. Possibly one may also know if reserved functions are used illegally (if X-response is generated for these).

Early modules in which A and F are not fully decoded do not give this information. They can be recognised because they do not generate X. However, if such modules are modified to generate the X signal when the station is addressed (X = N) as indicated in EUR 4100e (1972), the described method no longer works. Imprecise working of the X-response causes erroneous information on module characteristics.

Information not obtained through Q and X

Information which cannot always be obtained with certainty through the above method are:

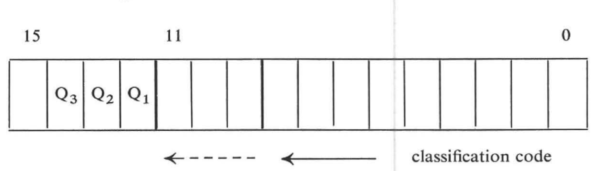
- Is Q used and in which mode?
- How many LAM sources, and what generates LAM?
- Are B, I, C, Z, P1 to P5 used and how?
- How many registers? Normally one would know this from the X-response, but not with certainty; the same register may both be overwritten by F(16) and read out by F(0).
- How many bits per register?
- Module width.
- What type of module? Binary, BCD, 2's complement register content? Range, Resolution, Accuracy? Frequency of operation? I/O signal levels and Polarity? Connector used? Any manual controls?

Some of this information about the module can be provided by the Module Descriptor, but certainly not all, not even coded. So we have to select what to have in and what to leave out.

THE MODULE DESCRIPTOR

A Module Descriptor which includes the 4-decimal classification code described in Ref. 1 provides, together with the Q- and X-response, most of the characteristics of a module which are related to the Dataway, and a few other as well.

Most new mini-computers have 16-bit words, and many 12-bit computers are in use. So we settle for a 16-bit Module Descriptor with the 'essentials' in the 12 least-significant bits.



This leaves 4 bits for other purposes. The Q-response modes provided by the module are given by bits 12 to 14, where

Q_1 = address scan mode;
Q_2 = repeat mode;
Q_3 = stop mode.

Bit 15 (and bit 11) should be reserved for other uses.

With this, it is possible to discover all Dataway—related characteristics except those concerning use of I, C, P1 and P2 buslines, P3 to P5 patch contacts, and perhaps some uncertainties in the number of LAM sources if a LAM Request Register is used.

REFERENCE

1. Nicolaysen, O. Ph., Decimal Classification of CAMAC Instrumentation, *CAMAC Bulletin*, No. 7 (1973) p. 33.

3

ISOLATOR STAGE FOR THE CAMAC BRANCH HIGHWAY SYSTEM

by

W. Tebra

FOM-Instituut voor Atoom- en Molecuulfysica, Amsterdam, The Netherlands

Received 5th June 1973

SUMMARY Interference from spurious common-mode signals and high-tension breakdowns in experiments can cause serious trouble in CAMAC systems. A light-coupled isolator stage in the branch highway is then helpful. Such a highway isolator has been used since January 1972, and drives several crates located at up to 100 m from the computer.

INTRODUCTION

In our laboratory on-line data acquisition and control of atomic collision experiments is performed with a PDP-15 computer and CA-15 CAMAC interface. The experiments are scattered throughout the laboratory, at distances up to about 100m from the computer.

Breakdowns in the high-tension equipment of the experiments are a regular phenomenon. They not only interfere with the data but also sometimes destroy the integrated circuits. To protect the computer and its peripherals, and to decrease the common mode interference, we interposed a light-coupled isolator stage between the highway bus of the CA-15 and the cable (Fig. 1). This considerably improves the low frequency common mode rejection and the protection against damage proved to be good.

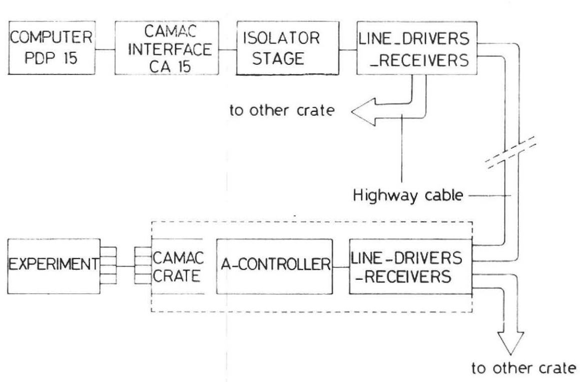


Fig. 1 Lay-out of the CAMAC Connection with Isolator Stage.

An ac-voltage of 500Vrms (50Hz) between the highway cable and interface now introduces no spurious signals. Direct discharges of 2 Joule by 3kV from a capacitor introduce an interference of 1.5V in the interface. Discharges of 10 Joule by 10kV are not harmful to the cricuits but they cause erroneous signals.

THE ISOLATOR STAGE

The isolator stage itself can withstand 2500V, but we limited the possible maximum voltage over the stage to about 300V by means of a non-linear resistor.

For the highway signals we used 91 isolators of Monsanto type MCD2. We chose the MCD2 because of its fast response. It is possible to transfer signals at up to 10MHz through the isolator stage. There are 48 isolators for the bidirectional BRW lines, 29 for the computer-crate direction, i.e. BTA, BG, BCR, BN, BA, BF, BZ and BX lines, and 14 for the other direction, i.e. the BD, BTB, BQ and BX lines. After the light-coupled isolator we use symmetrical line drivers and receivers. These units present normal CAMAC ports to the isolator and crate controller. Because the signals pass through several gates the delay for them is not necessarily the same. We have observed a time difference of about 50ns with selected photocouplers.

ACKNOWLEDGEMENTS

This work is part of the research program of the Stichting voor Fundamenteel Onderzoek der Materie (Foundation for Fundamental Research on Matter) and was made possible by financial support from the Nederlandse Organisatie voor Zuiver-Wetenschappelijk Onderzoek (Netherlands Organization for the Advancement of Pure Research).

REFERENCE

Tebra, W., and van Randeraat, B., A Lightcoupled State in the CAMAC Highway System. *Nucl. Instrum. Methods* (to be published).

nufacturers to produce Dataway connectors of lower insertion force.

A number of manufacturers are now producing power supplies, Type CP-1, based on the description in Appendix E of AEC Report TID-25877 (also issued as Supplement to *CAMAC Bulletin* No. 6). This has provided ready power supply interchangeability.

A Dataway circuit-board tester has been developed and tested under the auspices of the NMWG. The tester checks for both open and short circuits on essentially all of the approximately 2100 connections on the Dataway. Details of the test unit can be obtained from Lee J. Wagner, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720.

Analogue Signals Working Group

Chairman: D.I. Porat, Stanford Linear Accelerator Center, Stanford

This Working Group (NAWG) and the ESONE counterpart (EAWG) have been collaborating on extension of the CAMAC Specifications of Amplitude Analogue Signals to cover both slow and fast signals. Agreement on a final version appears to be close at hand.

ESONE ANNOUNCEMENTS

NEW COMMITTEE MEMBERS

Since the last Bulletin Issue, the ESONE Committee has been pleased to welcome the following laboratories as full members of the Committee:

— Istitutul de Fizica Atomica, Bucaresti, Roumania, whose representative will be Mr. M. Patratescu, Cas Postala No. 35, Bucaresti, Roumania.

— Centre de Recherches Nucleaires, Strasbourg, France.

Laboratoire d'Électronique et d'Instrumentation Nucleaire du Centre Universitaire du Haut Rhin, Mulhouse, France.

Laboratoire des Applications Électroniques de l'École d'Ingénieurs Physiciens, Strasbourg, France.

These three laboratories will have one representative who has not yet been nominated.

Availability of Translations of CAMAC Specifications

The reference texts of the CAMAC specification contained in EURATOM Reports EUR 4100e (1972), EUR 4600e (1972), EUR 5100e (1972) are in English and are being translated into French (f), German (d) and Italian (i). In December 1973 at least preprints of these texts are likely to be available as follows:

4100 d, f.
4600 f, i
5100 d, f, i

BULLETIN ANNOUNCEMENTS

AVAILABILITY OF CAMAC BIBLIOGRAPHY

All Bulletin subscribers will receive, with this Issue, a copy of the Supplement to Bulletin No. 8 "CAMAC Bibliography".

Additional copies of the Supplement are available and can be obtained from:

Commission des Communautés Européennes,
DG XIII–CID,
29, rue Aldringer, Luxembourg

and the price per copy, which will also cover postal charges, is 30 BFr or equivalent in any other currency.

NEW PRODUCTS

DATA MODULES (I/O Transfers and Processing)

Digital Serial Input Modules

Hex 24-bit 100 MHz Scaler

The Kinetic Systems Model 3615 is a single-width CAMAC module containing six 24-bit scalers. The scalers accept fast terminated input signals with frequencies from d.c. to greater than 100 MHz. Overflow latches are provided which can be set either after the 16th bit or the 24th. The scalers can be cleared by dataway command or by an unterminated fast-logic signal at the front panel. They also can be inhibited by either means.

Ref. Kinetic Systems

Digital Parallel Input Modules

3x16-bit Input Gate

The Input Gate Type 1063 is a single-width CAMAC module designed to enable up to 48 messages to be communicated to a system controller/computer. For ease of handling the 48 inputs are divided into three groups of 16.

Complete electrical isolation is provided by opto-couplers between the incoming messages and the CAMAC system itself. The couplers can be powered from external sources or from the module.

The module is intended for applications in almost any industrial automation system requiring the cyclic acquisition of digital data.

Ref. Borer Electronics AG

Model J007 Input Gate

The Jorway Model J007 Input Gate is designed for applications where data from many sources is to be read onto the dataway. The 24-bit input gate can be selected by a p.c. board switch to have either low-true or high-true input characteristics. A binary 6-bit output from the module allows selection of up to 64 input sources. Strobe signals are generated by dataway commands for use in programing external devices such as A to D converters. A LAM signal is generated on the dataway from the external sources to signify that the data is ready to be taken. All signals for external sources are available from a 36-pin edge-connector located above the normal dataway connector. Options are also available for either a front-panel or rear-panel 2DB52P connector.

Ref. Jorway Corporation

Balanced Line Input/Output Registers

The Kinetic Systems Models 3030 and 3430 are single-width CAMAC modules that provide for input and output using balanced lines. They both provide 16-bit data paths. The Model 3030 provides 16 differential drivers while the Model 3430 provides 16 differential receivers. The receiver module also has 7 differential drivers for transmitting an address allowing up to 128 external data sources. A LAM is provided in each module which can be set and sensed by an external device thereby allowing for synchronization of data transfers.

Ref. Kinetic Systems

Digital Output Modules

Relay Driver

This single-width CAMAC module, Type JRD10, contains 16 reed-relays driven from the dataway. The contact of each relay is available on the front panel. A switch on the front panel selects one of three modes of operation:

- 16 contacts 'permanent';
- 8 contacts 'permanent', 8 contacts 'short';
- 16 contacts 'short'.

'Permanent' ≡ contact set until register content changes.
'Short' ≡ contact closure of 1 sec. duration.

The contact ratings are 0.5 A max., 50 V max., 10 W max.

Ref. SAIP Schlumberger

Digital I/O, Peripheral and Instrumentation Interfacing Modules

CS0042 Magnetic Tape Deck Interface

This single-width module incorporates the command, status, and data registers necessary to interface such tape decks as the DEC TU10 and Racal T7000. The interface may also be used for connecting cassette tape recorders such as the Racal P70, into a system as an economic alternative to paper tape. Write data can be optionally loaded as 6, 8, 12, or 16-bit words into a 16-bit register whose output is provided with gates that are enabled in a stepped sequence determined by links so that data may be written onto tape in either 7 or 9-track format.

Demands for data transfer may be made by LAM requests or via a front panel trigger pulse which can be used to trigger an Autonomous Controller type 9033 into transferring data via a DMA channel of a computer. Power consumption +6 V at 1.2 Amp.

Ref. Nuclear Enterprises

Teletype Driver

This single-width CAMAC module, Type JTY10, connects a teletype ASR33, KSR33, etc. to a CAMAC crate.

The ASC II code is loaded from the W-lines (Write) and parallel to serial transcoding is automatically performed. The serial word is transferred to the teletype. The end of transfer generates a LAM.

The teletype sends a character and the serial code is converted to a parallel one in the module. The end of this conversion generates a LAM. The character is read from the R-lines (Read). In both cases, the Q response depends on the state of the module.

Two transfer speeds of 110 and 300 bauds are selected by a switch on the front panel. Other characteristics which can be chosen by internal straps are:

— Bit number of data (5-6-7 or 8);
— Bit number of stops (1 or 2);
— Parity control or not;
— Parity type (even or odd).

The output is between 24V and an open collector (PNP transistor) and 20mA is available.

The input signal comes from a contact in the teletype that gives a logical '1' in the module when the contact is open and a logical 'O' when closed.

Ref. SAIP Schlumberger

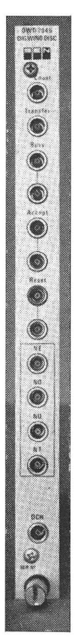
Model J154 Motor Controller

This single-width module is designed for use in controlling externally connected stepping-motor or servo controllers. The number of increments to be generated is written via the dataway into a 15-bit counter. A self contained oscillator clocks the counter down to zero while increment pulses are issued for external stepping motors. During counting, a contact closure occurs which may be used for servo-control. Included are pulse outputs and contacts for determining motor direction. Commands are also implemented for use in turn-on, turn-off, and reset of external devices. The progressing count-down of the 15-bit counter can be read on the dataway R lines at any time. An additional 8 bits of external status information can also be read. Connection options are available for either front or rear panel.

Ref. Jorway Corporation

Digital Data Handling and Processing Modules

Digital Window Discriminator



The DWD2046 is a compact single-width, second-generation CAMAC module, developed primarily as a sophisticated buffer-memory to reduce latency overhead in data acquisition systems. The unit has a digital window and coincidence logic capability, and will accept serial or parallel inputs. The buffer memory is a 16-bit shift register with 128 locations. A built-in DCH logic provides direct memory access transfers of the contents.

The unit has many applications in simple and multi-parametric coincidences PHA (pulse height analysis) systems, in multi-channel scaling, in Sampling Analysis and Fourier Analysers.

Designed for specific use in the SEN Spectrum Analyser, the DWD de-randomises event processing, and a speed of more than 400kcs is achieved with this system. However the unit is fully compatible with any ADC, and handles NIM/TTL levels.

Ref. SEN Electronique

Analogue Modules

Recorder Driver

This single-width CAMAC module, Type JXY10, is a digital-to-analogue converter allowing X-Y recorders to be driven by a CAMAC System. It can drive two recorders simultaneously.

An output on the front panel enables control of the pen-lift. Two 10-bit registers X and Y are loaded from the write lines (W1 to W10) and for each register a D-A converter delivers X and Y analogue signals needed by the recorder. A third register of 4 bits sets the mode of operation:

— X and Y are totally separated and independently loaded;
— Each new loading of Y increments 1 in the X register;
— Each new loading of X increments 1 in the Y register;
— Pen-lift contact always open, closed, or closed for a period that can be adjusted at each Y loading.

The X and Y outputs are 0 to +10V or −5V to +5V, 10mA. The pen-lift contact rating is 0.5A max., 50V max., 10W max.

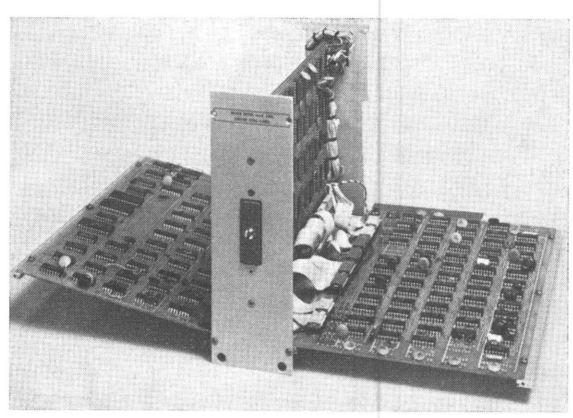
Ref. SAIP Schlumberger

SYSTEM CONTROL (Computer Couplers, Controllers and Related Equipment)

Interfaces/Drivers and Controllers

LABEN Branch Driver

LABEN, a Division of MONTEDEL, has recently developed, in co-operation with EURATOM of Ispra, a Branch Driver (model 5400) which allows CAMAC modules to be connected to the LABEN 70



and LABEN 701 digital computers. The unit is designed to control, via the CCA, up to 7 crates. Data transfer can be performed under program control and in program interrupt (or DMA mode) in either single- or block-transfer mode.

Special operating procedures have been studied to provide the highest level of control flexibility. Particular attention has been given to the LAM PATTERN read-in facility in order to easily identify the module that has generated the LAM signal.

Ref. LABEN

CS0044 Varian Interface Card

This unit is designed to plug into the interface-card option slot of the 9030 Controller and interfaces the Controller directly to the Varian 73, 620I or 620L series computers. Connection is made to the machine via a multi-way twisted-pair cable terminated in a 132-way plug.

Combined with the 9030 to form a CAMAC interface to the Varian 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 multi-crate systems by connection of a Branch Interface, Type 9031, module within the master crate.

Ref. Nuclear Enterprises

NPR Controller for DMA with a PDP-11

The Non-Processor Request Controller Type 1542 provides a simple, inexpensive means of performing fast block transfers to or from a PDP-11 Computer. Designed as a plug-in circuit card which fits inside the computer, the Controller makes direct connection with the Unibus and can therefore be used as a general purpose device or to enhance the capability of a CAMAC interface such as the Borer Type 1533A. The Controller itself does not limit the transfer rate and effectively provides direct memory access although requiring two Unibus cycles per transfer instead of one as for conventional DMA.

Three modes of operation are possible namely: Move, Histogram and Listing modes.

In the Move mode, CAMAC sub-addresses and memory addresses can be simultaneously scanned until a predetermined number of words have been transferred. The Histogram mode operates with a chosen single CAMAC sub-address (e.g. an ADC) and uses the data obtained to define memory addresses so that the respective contents are incremented by one, as appropriate for each transfer. Lastly, the Listing mode can be used to increment the memory address for each data word transferred.

All test and control operations associated with the transfer of a data block are performed instantly by hardware and use of the Unibus is limited to the movement of data only.

Ref. Borer Electronics AG

9033 Autonomous Controller

This is a double-width CAMAC module designed to interface the DMA facility of the PDP-11 Unibus to the CAMAC system. It is used in conjunction with the 9030/9032 PDP-11 interface modules.

Four separate DMA channel facilities are included in the module. Each DMA transfer can be triggered by an external pulse or level applied to one of its four trigger inputs. Two basic modes of operation are possible on each channel. Either block transfer of data or direct increment of data held in memory can be performed. The module contains four word-count registers so that block transfers can be made on each channel independent of the others. Power consumption, +6V at 2A.

Ref. Nuclear Enterprises

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

LAM Grader

The Model LG, LAM Grader, when used in conjunction with a Type A-1 Crate Controller will sort and select Interrupt requests both from the Dataway and from external sources. It accepts 23 'L' inputs from the controller and four external interrupts that are stored in the module. These Interrupt signals are internally patched according to the user's priority and sent back to the controller as graded 'L' signals (GL). These GL signals may also be masked under computer control by updating a masking register which will inhibit unwanted interrupts.

Three of the four external interrupts accepted by the module are triggered by a CAMAC logic pulse and the other is initiated by a front panel pushbutton. In response to these interrupts an output signal is generated indicating that the interrupt has been set in the module and will remain there until the bit is reset by function F10 or Z.

To allow proper use of the Graded L Command 'BG', additional GL inhibiting is provided. In response to a BG Command each crate can supply interrupt information on the BRW lines in multiples of three. This allows a seven-crate system to present its interrupt condition at one time, three interrupts from each of the seven crates and three additional that can be assigned to any crate. This gives the Branch Driver a composite picture of the systems interrupt-profile. If more detailed 'L' information is required, the Branch Driver will then command a controller to read all the GL's from that crate onto the BRW lines. To allow this gating in response to BG, a multiposition switch can select the bits to be used in that crate's BG response.

Indicators are provided to show when the module is addressed, either by command (N28+N30) or if a Graded L operation (BG) is taking place. An indicator is also provided to show if any GL requests are present.

Functions Used: F10, F16.
Size: Single width.
First Shipment: 6/73.

Ref. Joerger Enterprises

Branch Highway Serial Extension

This system allows the standard Branch Highway to be operated over long distances. It consists of a Serial Driver module and at least one Serial Receiver module. These CAMAC modules are connected over a serial highway containing 16 twisted-pairs, 8 for send and 8 for receive. The Serial Driver is connected to a standard Branch Driver. It accepts the CAMAC command, serializes it, transmits it to the Serial Receiver(s) which reconstructs the command and drives a standard Type A-1 system of one or more crates. The Serial Receiver also retransmits the serial data for use by other Serial Receivers. When the command is completed, the Serial Receiver transmits the response back to the Serial Driver which reconstructs the response and sends it to the Branch Driver. The complete CAMAC command is transmitted including the spare lines (BV). The timing (BTA, BTB) is reconstructed in each unit. To the Branch Driver, the input port of the Serial Driver will respond exactly like a Type A-1 system except that the cycle time will be longer. A complete CAMAC cycle will take approximately 1200 µsec.

The Branch Demand, BD, returns on a separate line to facilitate demand handling. Initialize, BZ, also uses a separate line to allow the system to be initialized by the driver, although both the Serial Driver and Receiver Initialize when their power is turned on. The remaining seven send and receive lines are used for data transmission.

This system provides a reliable, isolated long-distance link between CAMAC crates, primarily intended for control applications where speed is not an important factor. The system is asynchronous and therefore eliminates skew errors. The transmit and receive sections are in one MOS package. A data word contains a Start bit, two Stop bits, eight Data bits, and a Parity bit. Error checking is provided in both units. To avoid ground loops between stations, the inputs are all optically isolated and this could also be useful when stations are close together in a poor electrical environment and could simplify many system problems. The system has been designed around EUR 4600e and can handle up to seven crates. These crates may all be attached to one Serial Receiver or a system could contain seven Serial Receivers each driving one crate or any combination. Both the Serial Receiver and Driver provide a 100 ohm termination for the Branch highway. They are double-width CAMAC modules that use the Dataway only for power.

First Shipment: 7/73.

Ref. Joerger Enterprises

TEST EQUIPMENT

Dataway Related Testers and Displays

Manual Input Register

The Manual Input Register, Type 1041 is a single-width CAMAC module that facilitates the reading of a 16-bit data word (such as a parameter) composed manually by use of switches on the front panel. The status of the switches is read directly onto the Dataway by a Read command: no intermediate memory is included.

A push-button switch and a coaxial input provide alternative means for generating a LAM. The L-signal can be disabled when necessary and in any case disappears whenever the module is addressed.

A small measure of hardware programming is included so that the LAM can be cleared either by a normal Reset LAM command alone, or additionally in conjunction with a Read command. The choice is made with a single-wire link on the circuit board of the instrument.

Ref. Borer Electronics AG

CRATES, SUPPLIES, COMPONENTS, ACCESSORIES

Crates and Related Components/Accessories

CAMAC Crate With Power Supply

This crate, Type CJAL41, has a power unit designed to supply CAMAC modules. It delivers 400 W on ±6 V and ±24 V. The crate is equipped with floating edge-connectors and a wire-wrapped twisted-pair dataway for low cross-talk between lines. The cross-talk is down by a factor 5 to 10 compared to other CAMAC powered crates with dataways not having twisted-pairs, when the interference created on one wire by a standard CAMAC signal transmitted on the second wire of the same pair is measured. The specification of the power is as follows:

- Input: 220 V ± 10%/50 Hz
- Output: +24 V/ 3 A
−24 V/ 3 A
+ 6 V/24 A
− 6 V/16 A
- Maximum power: 400 W (maximum currents simultaneously supplied for all voltages)
- Stability: ±10% mains variation: 10^{-3}
temperature variation : 10^{-4}/°C
100% load variation : 10^{-3}
- Security: against overvoltage, overheat and supply failure.
- Ventilation: Air-blown by means of 3 fans at the front part of the crate and 3 other fans at the rear.

Ref. SAIP Schlumberger

Recommended or Standard Components/Accessories

CAMAC - PDP-11 Interface Harness

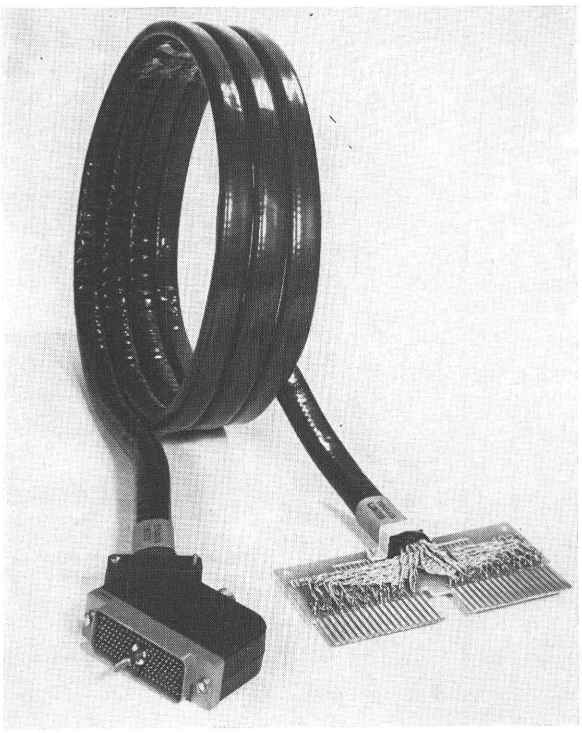
The latest item in the TEKDATA range of CAMAC interconnection products is a CAMAC to PDP-11 Unibus interface harness.

The harness connects a PDP-11 to CAMAC equipment directly without needing junction boxes or DEC Unibus harnesses.

TEKDATA's standard CAMAC 68, twisted-pair, multi-layer, ribbon cable is used (2 spare twisted pairs are available for use in the event of wire breakage in use) with overall screen and PVC sheath. Three options are available for screening: tinned copper mesh, tinned copper braid and stainless steel braid. These items are very flexible and manufactured to a high-quality level.

When ordering, the following code should be used 5805 P M-XXX. Replace P by S for 132-way socket; M refers to tinned copper mesh screen—replace by B or S for tinned copper braid or stainless steel braid respectively; XXX = length in meters.

Ref. TEKDATA Ltd.



Index to Manufacturer's News and New Products

NEWS

HOW TO CONTACT CAMAC WORKING GROUPS

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

ESONE-CAMAC WORKING GROUPS

ESONE-CAMAC Dataway Working Group (EDWG)

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

Secretaries: R.C.M. Barnes and I.N. Hooton, both of Electronics and Applied Physics Div., Building 347.2, AERE Harwell, Didcot, Berks. OX11 ORA, England.

ESONE-CAMAC Software Working Group (ESWG)

Chairman: I.N. Hooton, see above.

Secretary: H. Halling, Hernforschungsanlage Jülich GmbH, Zentrallabor für Elektronik/NE, 517 Jülich, Postfach 365, Germany.

ESONE-CAMAC Analogue Signals Working Group (EAWG)

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

ESONE-CAMAC Mechanics Working Group (EMWG)

Chairman: F.H. Hale, Electronics and Applied Physics Div., Building 347.2, AERE Harwell, Didcot, Berks. OX11 ORA, England.

ESONE-CAMAC Information Working Group (EIWG)

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

NIM-CAMAC WORKING GROUPS

NIM-CAMAC Dataway Working Group (NDWG)

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

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

Serial Systems Sub-group

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

Systems Compatibility Sub-group

Chairman: S.R. Smith, National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510, U.S.A.

NIM-CAMAC Software Working Group (NSWG)

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

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

NIM-CAMAC Mechanical and Power Supplies Working Group (NMWG)

Chairman: D.A. Mack, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720, U.S.A.

NIM-CAMAC Analogue Signals Working Groug (NAWG)

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

PAPER ABSTRACTS TRANSLATIONS

Modularity and CAMAC
H. Bisby

Summary

The instrumentation associated with nuclear sciences has always taken advantage of new data-processing techniques. The early introduction of the modular concept and its continuous development led to the CAMAC Standard. The modular concept is described and the advantages of CAMAC are examined.

Zusammenfassung

Die Kernwissenschaft hat neue Datenverarbeitungstechniken stets für ihre Instrumentierung genutzt. Die frühzeitige Einführung des modularen Konzepts und seine ständige Weiterentwicklung haben zu dem CAMAC-Standard geführt. Das modulare Konzept wird beschrieben und die Vorzüge des CAMAC-Systems werden behandelt.

Résumé

L'instrumentation liée aux sciences nucléaires a toujours bénéficié des nouvelles techniques de traitement des données. L'introduction, dès le début, du concept modulaire et son développement ininterrompu ont abouti au Standard CAMAC. Description du concept modulaire et examen des avantages du CAMAC.

Riassunto

La strumentazione delle scienze nucleari ha sempre sfruttato i vantaggi connessi alle nuove tecniche di trattamento dei dati. L'introduzione del concetto modulare e la sua continua evoluzione hanno condotto allo standard CAMAC. Nel documento viene descritta la concezione modulare e i vantaggi del CAMAC.

Samenvatting

Bij de instrumentatie in verband met de kernwetenschappen is steeds geprofiteerd van nieuwe technieken op het gebied van de verwerking van gegevens. De vroegtijdige invoering van het modulaire concept en de voortdurende ontwikkeling daarvan, heeft geleid tot de CAMAC-standaard. Er wordt een beschrijving gegeven van het modulaire concept en nader ingegaan op de voordelen die CAMAC biedt.

Резюме

Ядерная аппаратура всегда пользовалась новыми достижениями обработки данных. Давно применяемая идея блочной системы и её дальнейшее развитие привели к стандарту CAMAC. Описана концепция блочных систем и рассмотрены преимущества системы CAMAC.

The CAMAC Serial Highway - A Preview
R.C.M. Barnes

Summary

Advance information is given on a new CAMAC serial highway, complementing the existing parallel Branch Highway (EUR 4600e).This serial highway can be used, either alone or in conjunction with modems, over longer distances and in noisy environments. It can be connected to standard communications interfaces available on most computers.

Zusammenfassung

Der Bericht enthält erste Angaben über einen neuen seriellen CAMAC-Highway, der den vorhandenen parallelen Branch Highway (EUR 4600e) ergänzt. Dieser serielle Highway kann allein oder in Verbindung mit Modems für die Datenübertragung über grössere Entfernungen und bei hohem Geräuschpegel benutzt werden. Die Verbindung mit den bei den meisten Rechnern vorhandenen Standardanschlüssen für die Datenübertragung ist möglich.

Résumé

Informations préliminaires sur une nouvelle interconnexion de branche série qui complète l'interconnexion de branche parallèle déjà existante (EUR 4600e). Cette interconnexion série peut être utilisée soit seule, soit en association avec des modems, sur de plus longues distances et dans des milieux perturbés. Elle peut être reliée aux interfaces de communication standards qui existent dans la plupart des ordinateurs.

Riassunto

Vengono fornite anticipatamente informazioni su una nuova interconnessione serie CAMAC che si aggiunge al collegamento del ramo principale già esistente (EUR 4600e) Tale interconnessione serie puo' essere utilizzata da sola o insieme a modem su lunghe distanze e in ambienti rumorosi. Puo' essere collegata a interfacce standard di comunicazione disponibili nella maggioranza dei calcolatori.

Samenvatting

Voorafgaande informatie wordt hier verstrekt over de nieuwe CAMAC-hoofdlijn voor seriebewerking welke een aanvulling vormt op de bestaande vertakkingshoofdlijn voor parallelbewerking (EUR 4600e). Deze hoofdlijn voor seriebewerking kan hetzij op zichzelf, hetzij in combinatie met modems worden gebruikt over grotere afstanden en in luidruchtige omgevingen. De lijn kan worden aangesloten op standaard-interfaces voor communicatie die op de meeste computers aanwezig zijn.

Резюме

Предварительные информации о новой, последовательной магистрали CAMAC, которая дополняет существующую магистраль ветви (EUR 4600). Последовательная магистраль может работать или самостоятельно или совместно с модемами на большие расстояния и в присутствии помех. Может быть подключена к стандартным интерфейсам связи доступным в большинстве ЭВМ.

A Data Acquisition System Based on CAMAC and Supported by BASIC and FORTRAN
D. A. LePatourel, R. R. Johnson, D. Marquardt, D. Gurd

Summary

A 12 k minicomputer has been used with CAMAC and NIM equipment in an intermediate-energy nuclear scattering data acquisition system. The system is programmed in BASIC or FORTRAN, with sub-routines for input/output via CAMAC. The version with BASIC is most useful to experimenters, except where higher data rates require the use of FORTRAN.

Zusammenfassung

Ein 12k-Kleinrechner wird zusammen mit CAMAC- und NIM-Geräten in einem Datenerfassungssystem für Kernstreu-Experimente im mittleren Energiebereich eingesetzt. Das System wird in BASIC oder FORTRAN — mit Unterprogrammen für Ein- und Ausgabe über CAMAC — programmiert. Die Variante in BASIC ist für die Experimentatoren sehr zweckdienlich; für höhere Datenübertragungsraten muß jedoch FORTRAN benutzt werden.

Résumé

Un miniordinateur de 12k, associé à des éléments CAMAC et NIM, a été utilisé dans un système d'acquisition de données pour expériences de diffusion de particules nucléaires en moyenne énergie. Le système est programmé en BASIC et en FORTRAN, avec des sous-programmes d'entrée/sortie par CAMAC. La version BASIC est la plus utile aux expérimentateurs, sauf dans les cas où le taux élevé de données à acquérir nécessite l'utilisation du FORTRAN.

Riassunto

Un mini calcolatore da 12 k è stato usato con apparecchiature CAMAC e NIM in un sistema di acquisizione di dati sulla diffusione nucleare a media energia. Il sistema è programmato in BASIC o FORTRAN con sub-routine per l'ingresso/uscita tramite il CAMAC. La versione BASIC è estremamente utile per gli sperimentatori, salvo quanto dato il maggiore flusso di dati è necessario impiegare il FORTRAN.

Samenvatting

In combinatie met CAMAC en NIM-uitrusting is gebruik gemaakt van een 12k-minicomputer bij een verwervingssysteem voor gegevens over nucleaire verstrooiingsdoorsneden bij intermediaire energie. Het systeem is geprogrammeerd in BASIC of FORTRAN, met subprogramma's voor in- en uitvoer via CAMAC. De versie met BASIC is bijzonder nuttig voor experimentele doeleinden, behalve indien het gebruik van FORTRAN vereist is voor grotere gegevenssnelheden.

Резюме

В системе сбора данных для эксперимента ядерного рассеяния в области средних энергии применено миникомпутер с памятью 12 к совместно с аппаратурой CAMAC и NIM. Программы ввода и вывода данных через CAMAC написано на языках Базик и фортран. Версия на Базике является более удобной для экспериментаторов за исключением случаев большой скорости передачи.

CAMAC Applications in the Central Electricity Research Laboratories

E. G. Kingham and R. E. Martin

Summary

The paper reviews various applications of CAMAC in a multi-discipline research laboratory. Two autonomous systems are used for data logging and supervision. Other autonomous systems control and collect data from an electron-beam analyser and X-ray diffractometer. A computer-based system is used for data acquisition and processing.

Zusammenfassung

Es wird über verschiedene CAMAC-Anwendungen in einem multidisziplinären Forschungslaboratorium berichtet. Für die Datenabfrage und die Überwachung werden zwei autonome Systeme benutzt. Weitere autonome Systeme dienen zur Steuerung und Datenaufnahme von einem Elektronenstrahl-Analysator und einem Röntgendiffraktometer. Für die Datenerfassung und -verarbeitung wird ein rechnergeführtes System benutzt.

Résumé

Cet article passe en revue diverses applications CAMAC dans un laboratoire de recherches pluridisciplinaire. Deux systèmes autonomes sont utilisés pour l'acquisition des données et la surveillance. D'autres systèmes autonomes contrôlent et collectent les données fournies par un analyseur à balayage électronique et par un diffractomètre à rayons X. Un système avec ordinateur est utilisé pour l'acquisition et le traitement des données.

Riassunto

Vengono passate in rassegna varie applicazioni CAMAC in un laboratorio di ricerche multidisciplinari. Vengono usati due sistemi autonomi per la catalogazione e la supervisione dei dati. Altri sistemi autonomi controllano e raccolgono i dati da un analizzatore a elettroni e da un diffractometro a raggi X. L'acquisizione dei dati e il trattamento vengono effettuati tramite un sistema con calcolatore.

Samenvatting

In dit document wordt een overzicht gegeven van verschillende toepassingen van CAMAC in een onderzoeklaboratorium voor uiteenlopende wetenschappelijke gebieden. Voor datalogging en supervisie wordt gebruik gemaakt van twee autonome systemen. Andere autonome systemen dienen voor het controleren en verzamelen van gegevens van een elektronenbundelanalysator en een röntgendiffractiemeter. Voor het verkrijgen en het verwerken van de gegevens wordt gebruik gemaakt van een op een computer gebaseerd systeem.

Резюме

Расмотрено разные применения CAMAC-а в многопрофильной научной лаборатории. Две автономиые системы использовано для сбора данных и контроля. Другие автономные системы собирают данные и управляют анализатором пучка нейтронов и X-лучевым спектрометром. Базированые на ЭВМ системы, применено для сбора и обработки данных.

CAMAC Branch Driver for Laben Computers

L. Stanchi

Summary

A branch driver for use with Laben 70 and 701 computers is described. It contains features for fast handling of special LAM's, for address scans over an unknown number of registers, and for direct transfer of data between modules.

Zusammenfassung

Eine zentrale Steuerung für den Einsatz mit Laben-Rechnern 70 und 701 wird beschrieben. Sie ist für schnelle Verarbeitung spezieller Anforderungen, sequentielle Adressierung über eine unbekannte Anzahl von Registern sowie für direkte Datenübertragung zwischen Moduln ausgelegt.

Résumé

Description d'une commande de branche pour ordinateurs LABEN 70 et 701. Cette commande contient des dispositifs pour le traitement rapide de LAM spéciaux, pour des scrutations d'adresses sur un nombre de registres inconnu et pour le transfert direct de données de tiroir à tiroir.

Riassunto

Viene descritto un elemento di comando di ramo da impiegare con i calcolatori LABEN 70 e 701. Esso è concepito in particolare per il trattamento rapido di LAM speciali, per la scansione di indirizzi su un numero incognito di registri e per il trasferimento diretto di dati fra moduli.

Samenvatting

In dit document wordt een beschrijving gegeven van branchbekrachtiging voor gebruik in combinatie met Laben 70 en 701 computers. Deze vertoont speciale kenmerken voor een snelle verwerking van bijzonder LAM's, voor adresaftasting bij een onbekend aantal registers, en voor rechtstreekse overdracht van gegevens tussen modules.

Резюме

Описан контроллер ветви для ЭВМ Laben 70 и 701 в котором возможна быстрая обработка специальных заявок LAM, сканирование адресов при заранее неизвестном количестве регистров как и прямая передача между модулями.

Developments in Hardware and Software for the 7025 Programmed Dataway Controller

L. D. Ward and R. C. M. Barnes

Summary

Many successful CAMAC systems use the Harwell/Nuclear Enterprises 7025 programmed Dataway Controller. The programs have mostly been written in machine code and held in 256-word read-only stores. New developments described in this paper provide assembly-level programming facilities and a 2730-word read-write store for programs and data.

Zusammenfassung

Viele erfolgreiche CAMAC-Systeme arbeiten mit der programmierten Datenwegsteuerung 7025 von Harwell/Nuclear Enterprises. Die überwiegend in Maschinencode geschriebenen Programme sind in Festspeicher mit 256-Worten eingegeben. Als neue Entwicklungen werden die Programmierung in Assemblersprache und ein 2730-Wort-Lese-Schreib-Speicher für Programme und Daten beschrieben.

Résumé

Un grand nombre de systèmes CAMAC donnant toute satisfaction utilisent le contrôleur de châssis programmé Harwell/Nuclear Enterprises 7025. La plupart des programmes ont été écrits en code-machine et stockés en mémoires mortes de 256 mots. Cet article décrit de nouveaux perfectionnements, procurant des possibilités de programmation au niveau de l'assemblage ainsi qu'une mémoire lecture-écriture de 2730 mots pour les programmes et les données.

Riassunto

In molti sistemi si usa con successo il modulo di controllo programmato Harwell/Nuclear Enterprise 7025. I programmi sono scritti generalmente in codice macchina e memorizzati in memorie a 256 parole per sola lettura. I recenti sviluppi descritti nel documento riguardano dispositivi di programmazione a livello assembler e una memoria per lettura e scrittura a 2730 parole per programmi e dati.

Samenvatting

Bij een groot aantal succesvol werkende CAMAC-systemen wordt gebruik gemaakt van de Harwell/Nuclear Enterprises 7025 Programmed Dataway Controller. De programma's zijn voor het merendeel gesteld in machinetaal en opgeslagen in uitsluitend uitleesbare geheugens van 256 woorden. De nieuwe ontwikkelingen die in dit document zijn beschreven resulteren in programmeringsvoorzieningen op assembleerniveau en een 2730-woorden lees/schrijfgeheugen voor de programmen en de gegevens.

Резюме

Во многих системах CAMAC успешно применяются програмные контроллеры типа Harwell 7025. Чаще всего программы создаются в машинном коде и сохраняются в постоянной памяти ёмкостью до 256 слов. Описанные новые разработки касаются языка ассемблера как и применения памяти 2370 слов для хранения программы и данных.

A Serial Crate Controller

F. Buschbeck and E. Neuwirth

Summary

This paper describes a serial CAMAC crate controller for smaller systems. Each byte is a unique message, thus avoiding problems of message synchronisation. There is a full-duplex link from each crate controller to the computer.

Zusammenfassung

Es wird ein serieller CAMAC-Cratecontroller für Anwendung in kleineren Systemen beschrieben. Jedes Byte ist ein

eindeutiger Befehl, Probleme der Satzsynchronisation fallen dadurch weg. Jeder Cratecontroller soll über eine eigene full-duplex Leitung an den Rechner angeschlossen werden.

Résumé

Le présent article contient une description d'un contrôleur de châssis série destiné à des petits systèmes. Chaque byte est un message unique, ce qui élimine les problèmes de synchronisation des messages. Un circuit «full-duplex» relie chaque contrôleur de châssis à l'ordinateur.

Riassunto

Si descrive un modulo di controllo serie per piccoli sistemi. Ciascun byte è un unico messaggio per cui si evitano i problemi di sincronizzazione dei messaggi. Ciascun modulo di controllo è collegato al calcolatore mediante un collegamento duplex completo.

Samenvatting

In dit document wordt een beschrijving gegeven van een serie-CAMAC cratecontrollen voor toepassing in kleinere systemen. Elke byte is een duidelijk enkel bevel waardoor problemen in verband met synchronisatie van mededelingen worden voorkomen. Elke cratecontroller beschikt over een eigen full-duplexverbinding met de computer.

Резюме

Описан контроллер последовательного типа для крейта CAMAC в небольших системах. Каждый байт является отдельным сведением, что упрощает синхронизацию. К каждому контроллеру крейта присоединяется полную, дуплексную линию связи.

Derandomising CAMAC Input Module

R. Klesse

Summary

This CAMAC module is a last-in first-out buffer that can accept randomly-timed data words and transfer them via the Dataway to a computer. It is used when the transfer rate to the computer is not sufficient for the peak data rate, but can handle the mean rate.

Zusammenfassung

Dieser CAMAC-Modul ist eine «last in — first out» - Puffereinheit, die eine Zufallsfolge von Daten aufnehmen und über den Datenweg zu einem Rechner übertragen kann. Er wird eingesetzt, wenn die Übertragungsfrequenz zum Rechner nicht für die gewünschte Doppelimpulsauflösung der Ereignisse ausreicht, wenn aber der mittleren Übertragungsgeschwindigkeit (jedoch) entsprochen werden kann.

Résumé

Ce module CAMAC est une mémoire tampon «dernier entré — premier sorti» qui accepte les données arrivant à des instants aléatoires et les transfère à un ordinateur via l'Interconnexion. Il est utilisé lorsque la vitesse de transfert à l'ordinateur est insuffisante pour absorber le débit maximal de données, alors que le débit moyen peut être traité.

Riassunto

Questo modulo CAMAC è un disaccoppiatore che riceve dati in successione casuale e li trasferisce al calcolatore tramite l'Interconnessione in modo tale che l'ultimo entrato viene trasferito prima. Esso viene impiegato quando la cadenza di trasferimento al calcolatore è insufficiente per la cadenza di picco ma puo' trattare la cadenza media.

Samenvatting

Deze CAMAC moduul is een (laatst-in-eerst-uit) buffergeheugen dat willekeurig in de tijd komende gegevenswoorden kan opnemen en via de Dataway overbrengen naar de computer. Hiervan wordt gebruik gemaakt wanneer de overbrengingssnelheid van de computer niet voldoende is voor de pieksnelheid van de gegevenstoevoer doch deze de gemiddelde snelheid hiervan kan verwerken.

Резюме

Описанный блок CAMAC является буфером, который принимает случайно распределенные слова данных и передает их через магистраль к ЭВМ начиная с последнего события. Блок применяется в случаях когда частота передачи к ЭВМ не достигает максимальной частоты прихождения данных однако является достаточной, учитывая среднее значение этой частоты.

Some Aspects of a Compiler Writing System and the Implementation of the CAMAC Language

K. H. Degenhardt, U. Marx-Rehbein, W. Woletz

Summary

Recent work at the Hahn-Meitner-Institut to automate the writing of compilers for programming languages is presented. The first application of the Compiler Writing System (CWS) will be the implementation of a compiler for the CAMAC language.

Zusammenfassung

Neuere Arbeiten im Hahn-Meitner-Institut zur Automatisierung des Schreibens von Kompilern für Programmiersprachen werden beschrieben. Als erste Anwendung des Compiler Writing System (CWS) soll ein Kompiler für die CAMAC-Sprache erstellt werden.

Résumé

Présentation des travaux récents effectués au Hahn-Meitner-Institut, en vue de l'automatisation de l'écriture des compilateurs utilisés pour les langages de programmation. La première application du «Compiler Writing System» (CWS) sera la mise en œuvre d'un compilateur pour langage CAMAC.

Riassunto

Vengono presentate le recenti attività svolte presso l'Hahn Meitner- Institut per automatizzare la scrittura dei compilatori di linguaggi di programmazione. La prima applicazione del Compiler Writing System (CWS) sarà la preparazione di un compilatore per il linguaggio CAMAC.

Samenvatting

In dit document wordt ingegaan op recente werkzaamheden bij het Hahn-Meitner-Institut met het oog op een geautomatiseerde samenstelling van compilators voor programmeringstalen. De eerste toepassing van het Compiler Writing System (CWS) is de uitvoering van een compilator voor de CAMAC-taal.

Резюме

Представлены, ведущиеся в Институте Hahn-Meitner, последние разработки в области автоматизации создания компайлеров для языков программирования. Первым применением системы писания компайлеров (CWS) будет язык CAMAC.

Proposal for a Power Failure Signal from the CAMAC Power Supply to the Control Station

C. Eck, F. Iselin, J.-P. Vanuxem

Summary

A Power Failure feature is recommended to provide the controller with an early warning signal that the mains supply has failed. This allows action to be taken to save the contents of registers in the CAMAC crate while the d.c. supply voltages are still within tolerances.

Zusammenfassung

Ein «Power Failure» (PF) Signal wird empfohlen, das ein Zusammenbrechen der Netzspannung frühzeitig anzeigt. Dies Signal ermöglicht das Auslesen aller Register eines CAMAC-Rahmens, bevor eine der Gleichspannungen unter den erlaubten Grenzwert fällt.

Résumé

Un dispostif «Défaut d'alimentation» est recommandé : il permet de donner, dès le début, au contrôleur, un signal lui indiquant la défaillance du circuit d'alimentation principal, ce qui permet d'intervenir pour préserver le contenu des registres du châssis CAMAC, avant que les tensions d'alimentation ne soient hors tolérances.

Riassunto

Si raccomanda un indicatore di guasti per informare il modulo di controllo tramite un segnale immediato che la rete di alimentazione è interrotta. E' possibile così prendere provvedimenti per salvare il contenuto dei registri nel contenitore CAMAC quando le tensioni continue di alimentazione sono ancora entro le tolleranze prescritte.

Samenvatting

In dit document wordt de toepassing aanbevolen van een voorziening in geval van het uitvallen van de voedingsstroom zodat bij de besturing tijdig een signaal wordt ontvangen dat de stroomtoevoer is onderbroken. Hierdoor kunnen maatregelen worden genomen om de inhoud van de registers in het CAMAC-crate te behouden zolang de voltages van de voedingsgelijkstroom nog binnen de toelaatbare grenzen blijven.

Резюме

Рекомендуется применение сигнала « Неисправность питания », который предупреждает о ожидаемом отсутствии питания. Это позволяет сохранить содержание регистров крейта CAMAC пока питающие напряжения еще находится в пределах толеранции.

Module Descriptor

O. Ph. Nicolaysen

Summary

The revised CAMAC specification recommends an address for accessing a module descriptor word, but does not define the contents of the descriptor. This paper reviews the sources of information about the characteristics of a CAMAC module, and proposes a 16-bit descriptor word.

Zusammenfassung

Die überarbeitete CAMAC-Spezifikation empfiehlt eine Adresse für den Zugriff auf ein Modul-Deskriptorwort, ohne jedoch den Inhalt des Deskriptors zu definieren. Der Bericht legt dar, wie Informationen über die Charakteristiken eines CAMAC-Moduls erlangt werden können, ein 16-Bit-Deskriptorwort wird vorgeschlagen.

Résumé

Les spécifications CAMAC révisées recommandent une adresse qui permet l'accès à un mot descripteur du tiroir mais elle ne précise pas le contenu du descripteur. Le présent article passe en revue les sources d'information relatives aux caractéristiques d'un tiroir CAMAC et propose un mot descripteur de 16 bits.

Riassunto

Nelle caratteristiche rivedute del CAMAC si raccomanda un indirizzo per poter accedere ad un descrittore di modulo, senza definire però il contenuto del descrittore. Il presente documento passa in rassegna le fonti di informazione in merito alle caratteristiche del modulo CAMAC e propone un descrittore a 16 bit.

Samenvatting

In de herziene CAMAC-specificatie wordt een adres aanbevolen voor het toegankelijk maken van een module beschrijvingswoord, maar wordt de inhoud van de descriptor niet gedefinieerd. In dit document wordt een overzicht gegeven van de bronnen van informatie over de karakteristieken van een CAMAC-module en wordt een 16-bit beschrijvingswoord voorgesteld.

Резюме

Модифицированные спецификации CAMAC рекомендуют адрес для дескриптора блока но не определяет содержания этого слова. Рассмотрены источники информации характерные для блоков CAMAC и предложено 16-битовое слово дескриптора.

Isolator Stage for the CAMAC Branch Highway System

W. Tebra

Summary

Interference from spurious common-mode signals and high-tension breakdowns in experiments can cause serious trouble in CAMAC systems. A light-coupled isolator stage in the branch highway is then helpful. Such a highway isolator has been used since January 1972, and drives several crates located at up to 100 m from the computer.

Zusammenfassung

Gleichtakt-Störsignale und Unterbrechungen der Hochspannungsversorgung bei Experimenten können zu ernsten Störungen in CAMAC-Systemen führen. Die Probleme können durch eine Isolator-Stufe im Branch Highway überwunden werden. Ein solcher Isolator ist seit Januar 1972 im Einsatz; er steuert mehrere Rahmen, die bis zu 100 m vom Rechner entfernt sind.

Résumé

Au cours d'expériences, des signaux parasites en mode commun et des coupures de hautes tensions peuvent provoquer de graves perturbations dans les systèmes CAMAC. Un étage d'isolement optoélectronique placé sur l'interconnexion de branche est alors très utile. Un tel isolateur a été utilisé depuis janvier 1972; il commande divers châssis situés jusqu'à 100 m de l'ordinateur.

Riassunto

Interferenze da segnali spuri di modo comune e scariche ad alta tensione in esperimenti possono provocare gravi disturbi ai sistemi CAMAC. A tale scopo è utile installare uno stadio d'isolamento accoppiato a luce nel collegamento del ramo principale. Tale isolatore sul ramo è in uso dal gennaio 1972 e aziona vari contenitori situati fino a 100 metri di distanza dal calcolatore.

Samenvatting

Interferentie afkomstig van storende gemeenschappelijkemodussignalen en hoogspanningstoringen kunnen in CAMAC-systemen ernstige moeilijkheden veroorzaken. Een licht-gekoppelde isolatorfase in de hoofdlijnvertakking kan in een dergelijk geval nuttig zijn. Van een dergelijke hoofdlijnisolator wordt sinds januari 1972 gebruik gemaakt en bekrachtigt verschillende crates tot op een afstand van 100 m van de computer.

Резюме

Помехи от паразитных сигналов и высоковольтных разряжении в эксперименте могут быть причиной серёзных ошибок в системах CAMAC. Полезным является применение в ветви изолирующей степени со световом сцеплением. Такие степени используется с января 1972 г. при управлении несколькими крейтами расположенными на расстоянии до 100 м от ЭВМ.

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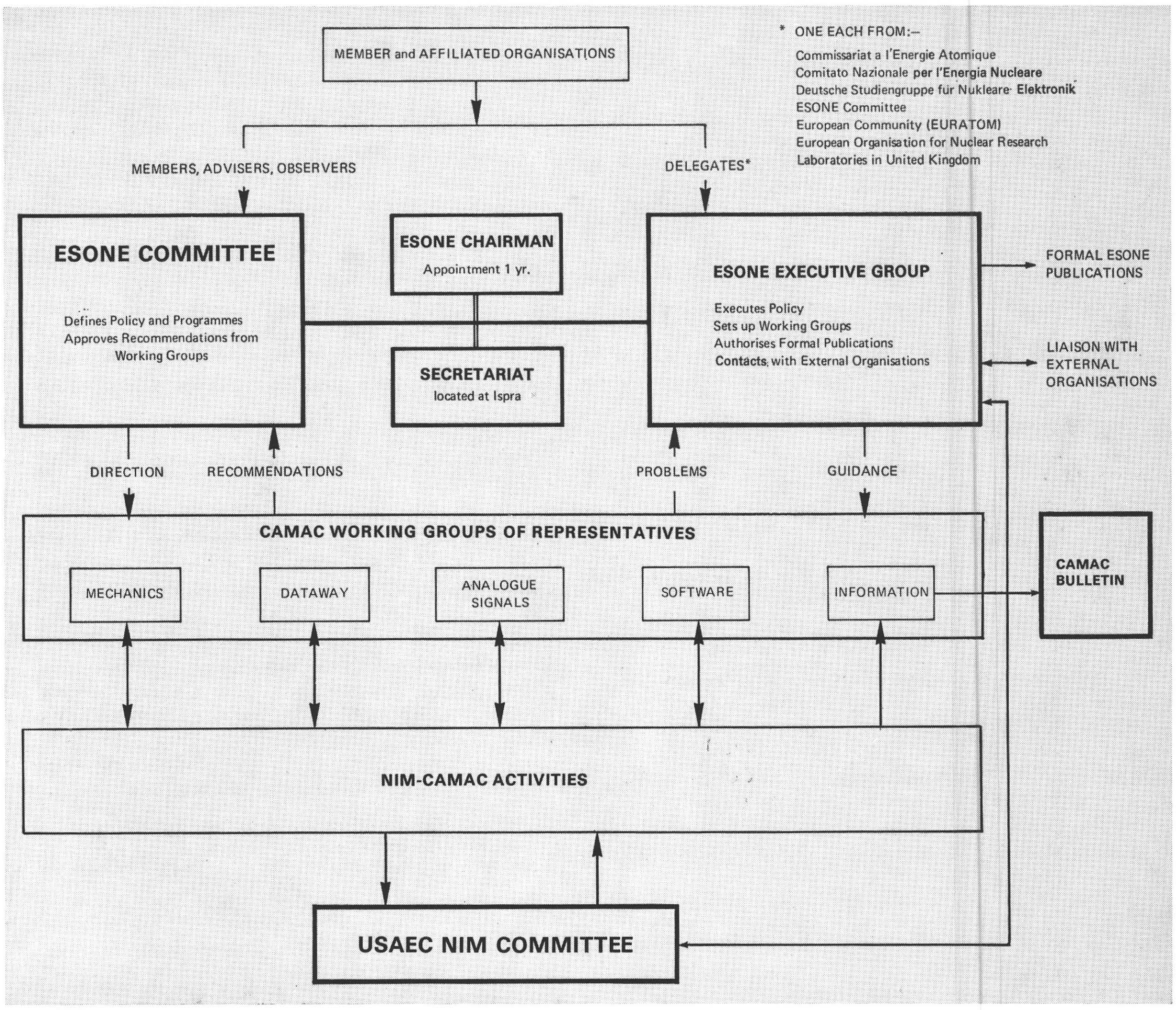

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