CAMAC
bulletin

A publication
of the
ESONE Committee

ISSUE No. 6
March 1973

WHAT IS CAMAC?

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

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

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

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

PRINCIPAL CONTENTS OF PREVIOUS CAMAC BULLETIN ISSUES

CONTRIBUTIONS TO FUTURE ISSUES*

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

Application Notes, Development Activities, Laboratory Reviews and Software:	Mr. W. Attwenger, SGAE, 1082 Wien VIII, Lenaugasse 10, Austria.
New Products and Manufacturer News:	Dr. H. Meyer, CBNM Euratom, Steenweg naar Retie, Geel, Belgium.
Product Guide:	Mr. O.Ph. Nicolaysen, N.P. Division, CERN, 1211 Geneva 23, Switzerland.
Bibliography and any ESONE News Items, etc.:	Dr. W. Becker, JRC Euratom, 21020 Ispra (Varese), Italy.

* ***DEADLINES FOR SUBMISSION*** **(issue No. 8).**
For articles and New Products: 15.6.1973.
For Product Guide and short news: 10.8.1973.

On the cover:

View of Grenoble, France. Middle-right is the Centre d'Etudes Nucleaires of the Commissariat à l'Energie Atomique where the ESONE General Assembly was held in 1966. The decision was taken at this Assembly to undertake a study which ultimately led to the specification of CAMAC.

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Distributed by:

Commission des
Communautés Européennes
29, rue Aldringen
Luxembourg

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COMITATO NAZIONALE
PER L'ENERGIA NUCLEARE

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SETTORE RICERCA NUCLEARE APPLICATA

Cari Lettori,

sono assai lieto di avere la possibilità, nella qualità di Presidente del Comitato ESONE, di indirizzarmi a Voi nel Bollettino N. 6, il primo del 1973.

Sono passati ormai due anni da quando nel Bollettino N. 1 l'allora Presidente, Michel Sarquiz, Vi domandava suggerimenti e critiche. Ma il ragguardevole consenso e la crescente diffusione del Bollettino hanno già dato una chiara risposta, confermando il grande interesse ovunque manifestato per il Sistema CAMAC.

E' un gradito dovere esprimere a nome del Comitato ESONE il più vivo ringraziamento della Commissione delle Comunità Europee per aver prontamente aderito alla nostra richiesta di pubblicazione e diffusione del Bollettino, avendo così contribuito ad una larga diffusione della conoscenza del CAMAC. Un particolare apprezzamento dell'opera svolta va al Gruppo di Lavoro Editoriale ed al Suo Presidente, Horst Meyer.

Nell'ultima riunione a Jülich (1972) si è potuto constatare che il Sistema CAMAC, ormai adulto, è conosciuto in Europa ed in America e la strumentazione modulare CAMAC è largamente impiegata in numerosi Centri Nucleari per l'elaborazione delle informazioni.

E' quindi ora venuto il momento di avviare un programma di ricerca e sviluppo e di diffusione delle conoscenze al di fuori del settore nucleare in vista di nuove applicazioni del Sistema CAMAC. Interessanti possibilità di nuove applicazioni esistono in astronomia, servizi medico-sanitari, controllo di processi industriali, misure e controllo di inquinamento ambientale, industrie minerarie, controllo navale, automazione di laboratori di ricerca.

Un'azione di promozione per stimolare le iniziative e facilitare lo sviluppo coordinato degli investimenti industriali in questi settori di attività è alla base del programma del Comitato ESONE per il 1973. Risultati importanti in tempi sufficientemente brevi non potrebbero peraltro ottenersi se non si disponesse dell'autorevole azione e dell'importante contributo organizzativo, altamente apprezzato, della Comunità Europea.

Brunello Rispoli
Presidente (1972-73) del Comitato ESONE

Dear Readers,

I am very happy to have this opportunity, as Chairman of the ESONE Committee, to address you in this first Bulletin of 1973. Two years have passed since Bulletin No. 1 when Michel Sarquiz, who was then the ESONE Chairman, invited your criticisms and suggestions for the content of the Bulletin. The ever increasing circulation and most favourable reception of the Bulletin have confirmed the great interest that is found everywhere for the CAMAC System and shown that the Bulletin satisfies a need among Users and Suppliers of CAMAC. Therefore, it is a great pleasure for me, on behalf of the Committee, to warmly thank the Chairman, Horst Meyer and other members of the Information Working Group for their dedication to the task of producing the Bulletin and the Commission of the European Communities for logistic support in publishing and distributing the Bulletin.

During the ESONE General Assembly in Jülich (October, 1972) it was clear that CAMAC was becoming firmly established in nuclear laboratories in West and East Europe, North America and elsewhere. The moment has now arrived to initiate a programme to promote further use of CAMAC outside the nuclear area. Interesting possibilities of new applications exist in astronomy, medical and health sciences, environmental monitoring and control, mining, ship control, automatic testing and process control. The objective of the Committee for 1973 should be to stimulate the programme and encourage industrial activity and investment in these areas.

I am sure that Committee Members will take effective action in their national zones, however significant results cannot be obtained within a short period of time without the valued support and co-operation of the Commission of the European Communities.

B. Rispoli

B. Rispoli

BIOGRAPHICAL NOTE

Born 1921. Graduated in Physics Rome University 1945.
Research physicist in the field of high energy physics and cosmic rays at Rome University.
Professor of Electronics at Institute of Physics, Rome University since 1960. Director of Electronics Laboratory, CNEN (Comitato Nazionale per l'Energia Nucleare) from 1957 to 1966.
At present in charge of the coordination of electronics, instrumentation, automation and computers in the CNEN Sector of Applied Physics.
Chairman of Sub-Committee 45B of International Electrotechnical Commission (IEC), "Health Physics Instrumentation" since 1968.

APPLICATION NOTES

1

A CAMAC SYSTEM FOR COMPUTER CONTROL OF SPECTROMETERS

by

M.R. Howells*, I.H. Munro* ** and L. Naylor**

University of Manchester* and Daresbury Nuclear Physics Laboratory**, England

Received 13th July 1972

SUMMARY This paper describes an automated control system for optical spectrometers. Each spectrometer is controlled by a CAMAC crate, and the crates are driven as a branch by a Honeywell 316 computer. Users specify spectrometer operations by typing parameters on the keyboard of a television monitor. The operations are carried out automatically, and the data are displayed.

INTRODUCTION

High energy electron synchrotrons can be used as intense sources of electromagnetic radiation for spectroscopy in the x-ray and vacuum ultra-violet regions of the spectrum. The special properties of a synchrotron light source—its smooth and calculable continuum spectrum, high vacuum and high degree of polarisation are currently being exploited by a number of groups around the world.

In the U.K. the Science Research Council has supported the establishment of a National Synchrotron Radiation Facility based on the 5 GeV electron synchrotron, NINA, at the Daresbury Nuclear Physics Laboratory. At present the facility has three monochromators designed and built by university user groups. This article describes the control and data collection system which has been constructed to drive these three monochromators. The system will be extended to accommodate additional instruments in the future.

The system design takes account of the following:

- All operations must be carried out remotely because of high radiation levels close to the synchrotron beam lines.
- The system must be able to carry out a complete spectral scan automatically.
- The user instructions to specify this must be simple and easy to use.
- The system must allow for expansion and alteration.
- Monitoring of data and system status must be carried out continuously.
- Data presentation must allow convenient recording and analysis.

SYSTEM DESIGN

The general approach to these problems has been to provide each monochromator with an identical set of basic equipment. This comprises stepping motor, shaft digitizer, input registers and counters. Each monochromator has a separate CAMAC crate through which all data logging and control operations are carried out. The crates each have a Type A controller and are driven as a branch by a Honeywell 316 computer via a Daresbury Laboratory designed branch driver.

Each crate has a Vista television monitor with a keyboard to enable interaction between the user and the system and to provide a certain degree of data monitoring. Additional monitoring is provided by a spectrum plot on a storage oscilloscope. Final output is on punched paper tape.

The whole system is permanently under the control of a program in the 316. This accepts information typed in by the user specifying a set of spectrometer operations. It then automatically executes the operations and displays and stores the data accumulated. The user may interrupt the program using the keyboard at any time during execution to specify changes in the sequence of operations.

SYSTEM DESCRIPTION

Fig. 1 is a block diagram illustrating the control and data handling hardware for one of the monochromators. Light from the synchrotron enters the instrument as shown and a diffracted beam passes out of the exit slit via the specimen into the detector. The output from the photomultiplier is digitized by a Daresbury Laboratory type 161 NIM unit so that a count rate proportional to the light intensity is recorded by the 7039 scaler. A second detector produces a reference count rate proportional to the light incident on the specimen. The purpose of this is to compensate for fluctuations in incident beam intensity by using the ratio of the two counts as a measure of the transmission of the specimen. A third 7039 scaler counts clock pulses.

The three scalers are arranged so that when any one of the three reaches its pre-set limit, an inhibit signal is applied to all three. This enables the user to stop counting at a time limit, a reference count limit or a signal count limit.

In order to scan through the spectrum, the diffraction grating is rotated by means of the stepping motor. This is driven by an 0707 driver which is triggered under program control by the 7045 delayed pulse generator. The shaft digitizer and up/down counter provide a check that the motor is stepping correctly and also enable an absolute position identification for the grating. This can be carried out independently of the rest of the system.

Two limit switches are provided to protect the system against overrun. If either of these is activated the motor is stopped and a bit is set in the 7014 input register. This can be interrogated by the program as required.

The remaining devices are concerned with interaction between the user and the computer, with loading and producing program tapes and the output of data. The LAM grader is currently pat-

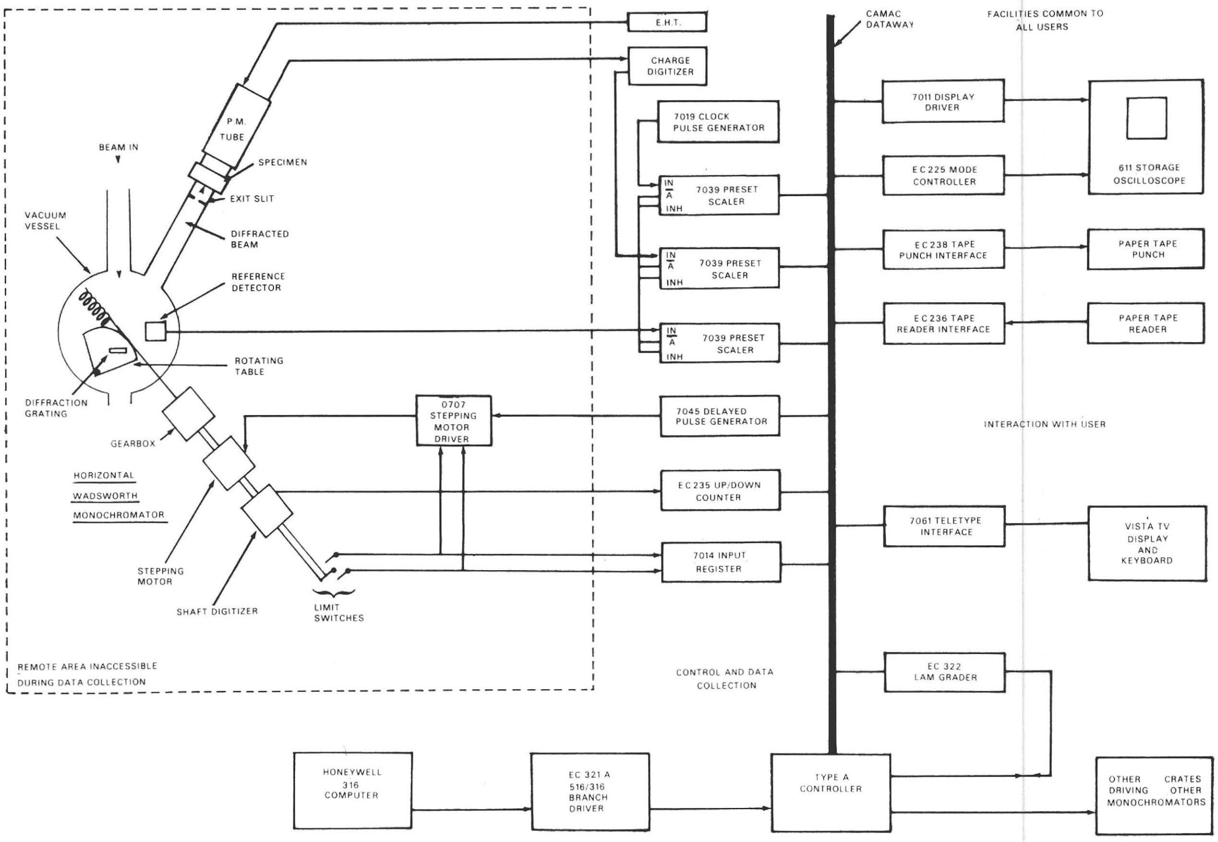

Fig. 1 Control and data handling hardware for one monochromator.

ched so that the only LAM which produces a GL signal is the input LAM on the 7061. Thus the only valid interrupt is produced by the keyboard.

PROGRAMMED OPERATIONS

The spectrometers scan through the spectrum by means of the stepping motor, so the number of steps moved is a co-ordinate (X) which is proportional to wavelength. The zero of the X scale is fixed arbitrarily.

At the start of a sequence, the user is required to type in six parameters specifying the operations required. These are:

(i) The initial value of X, (A).
(ii) The distance between measurement positions (ΔX).
(iii) The number of measurement positions.
(iv) The time limit for counting (T).
(v) The measurement count limit (C).
(vi) The reference count limit (R).

(Note that (v) and (vi) can be used either with a d.c. signal which is digitized to give a count rate (Fig. 1) or in a photon counting mode at very low light intensity.)
The standard sequence then proceeds as follows:

1. Move to A.
2. Pre-set the scalers to T, C and R respectively.
3. Count until one of the scalers reaches the pre-set limit.
4. Read the scalers, store the data and display them on the T.V. monitor and the storage oscilloscope.
5. Move ΔX steps.
6. Repeat 2, 3, 4 and 5 the specified number of times (N).
7. Punch all the data on paper tape (optional).
8. Finish.

During this sequence and at other times, the following facilities are available through keyboard interrupts.

— Pause and continue later.
— Display the grating position.
— Stop and restart with new parameters.
— Produce a paper tape of the data so far accumulated.
— Stop and transfer control to another crate and hence another monochromator.

At the end of the sequence the data are available as a set of four numbers for each counting position

MOTOR POSITION
COUNTING TIME
MEASUREMENT COUNTS
REFERENCE COUNTS

DEVELOPMENT OF THE SYSTEM

At present the system is able to carry out the standard sequence described above on only one monochromator at a time. However, the construction of a time sharing software system has been started and will be based on the standard Honeywell real time executive. The intention is that the first version of the system will allow each of six users to work as if they were the sole user. This is based on a branch of seven crates, one of which is a master control crate.

A second development of the system on which work has already started is the provision of a fast data link to the Daresbury Laboratory IBM 360/65. The link hardware is currently being commissioned and when available will open up a vast range of possibilities.

From the spectroscopists' point of view the increase in available computing power will bring a number of improvements within reach. It is proposed to install CAMAC driven servo-motors to control the separation and longitudinal position of the jaws of the monochromator exit slits. It will then be possible to maintain the monochromator in focus over a wide wavelength range and also to allow the instrument to function at any desired spectral resolution.

Another desirable development which is currently under study is to program the system to recognise regions of the spectrum of special importance, for example peaks or fine structure. This could be achieved by differentiation. The wavelength scan rate, counting statistics, and instrumental resolution could then be made especially favourable in the region of importance.

ACKNOWLEDGEMENTS

The authors wish to express their appreciation for the overall support of the computing and electronics group at Daresbury Laboratory and the financial support of the Science Research Council.

NEWS

CAMAC HIGHLIGHTS AT THE NUCLEAR SCIENCE SYMPOSIUM

Miami Beach, December 6-8, 1972

On Friday December 6, 1972 two full CAMAC Sessions were held at the IEEE 1972 Nuclear Science Symposium. The title of the papers presented has already been given in *CAMAC Bulletin*, No. 5.

Three invited papers covered the present status of the CAMAC specifications:

— CAMAC: A Review and Status Report by Louis Costrell
— CAMAC: Specifications by Fred A. Kirsten
— CAMAC: Standard Software by Satish Dhawan and Richard F. Thomas, Jr.

Within these lectures the main reasons for the CAMAC Standard were described and the 1972 Revision of the CAMAC Specifications and resulting compatibility aspects explained in some detail. The present status of discussions in the NIM and ESONE Dataway Working Groups for standardisation of the Organization of multicrate serial CAMAC Systems was presented to the auditorium. The serial highway is intended to complement the parallel branch highway described in EUR 4600e (1972).

CAMAC is used at present for data handling and/or control of accelerators at the following installations:

— National Accelerator Laboratory (NAL), Batavia, USA.
— TRIUMF (University of British Columbia, Vancouver, Canada).
— University of Eindhoven, Netherlands.
— Los Alamos Meson Physics Facility (LAMPF), USA.
— University of Indiana, USA.
— KFA Jülich, Germany.
— CERN Laboratory II, Geneva, Switzerland.
— Heavy Ion Accelerator, Darmstadt, Germany.
— NASA, USA.

The activities of the NIM and ESONE Software Working Groups for CAMAC Fontran subroutines and a CAMAC language were presented.

The difficulties encountered for general software can best be seen by realizing that:

— CAMAC modules are not specified in detail.
— Generality of the CAMAC system.
— Lack of uniformity in CAMAC computer interface.

With this in mind, areas in which software standardization may be possible and helpful were discussed.

Two extremely interesting panel discussions with the following topics were held during the CAMAC sessions.

— CAMAC: Fundamentals, Specifications, Status.
— CAMAC: Systems and Software.

The panel discussions were attended by nearly 100 participants.

In the questions raised many hardware, software and system aspects of the CAMAC System were covered.

In order to help to improve the understanding and use of the CAMAC System also in non-nuclear areas, the CAMAC sessions will appear as a tutorial issue in the IEEE Transactions on Nuclear Science.

During the Nuclear Science Symposium an exhibition was provided by a total of 30 companies of whom 11 were manufacturers of CAMAC systems, instruments and components and received a rather broad response.

(reported by: K. D. Müller)

2

AN AIRBORNE γ-SCINTILLOMETER

by

E. Mose Christiansen and P. Skaarup

Danish Atomic Energy Research Establishment RISØ, Roskilde, Denmark

Received 7th November 1972

SUMMARY A description is given of airborne instrumentation for uranium exploration. The NIM standard is used for the analogue part of the system, and the CAMAC standard for the data collecting part. The system is controlled by a programmable controller with hardware program modules.

INTRODUCTION

The search for uranium in Greenland is carried out by co-operation between several Danish institutions. One of them is Risø, where most of the instruments are made.

East Greenland is a rocky, cold, and unpopulated country (Fig. 1). An indication of possible uranium deposits there can be obtained by means of an aircraft equipped with suitable detectors and electronics.

Fig. 1 Head of Hurry Inlet, East Greenland, with the camp. (Photo B. Leth-Nielsen.)

Such electronics, partly in CAMAC, are at present under construction at Risø for use during the six-week-long summer season of 1973.

SYSTEM CONFIGURATION

A simplified diagram of the instrumentation is shown in Fig. 2. The analog part is built from NIM-units, while the control part is a one-crate CAMAC system without computer.

The detector box contains six parallel-connected 6″-diameter, 4″-high NaI(TL) detectors. The box is mounted so that the detectors look down at the landscape during flight. The signals from the detectors are brought to four single-channel analysers (SCA), where they are sorted into counts from uranium, thorium, potassium, and a total count. Each SCA is connected to one of the scalers in the quad-scaler module. An altitude meter with an analog output is connected to a CAMAC ADC. Other input parameters can be read into the system from the parameter unit, the real time clock, the timer, or the input module connected to control panels. One control panel is located near the pilot and is used to select different counting modes and programs.

The output units are a paper tape punch, a strip chart recorder, and the displays.

The three parallel displays are placed at the instrumentation, near the pilot, and in the camera assembly. They are numeric displays constructed from solid-state indicators. A background program updates the displays with the altitude and the real time.

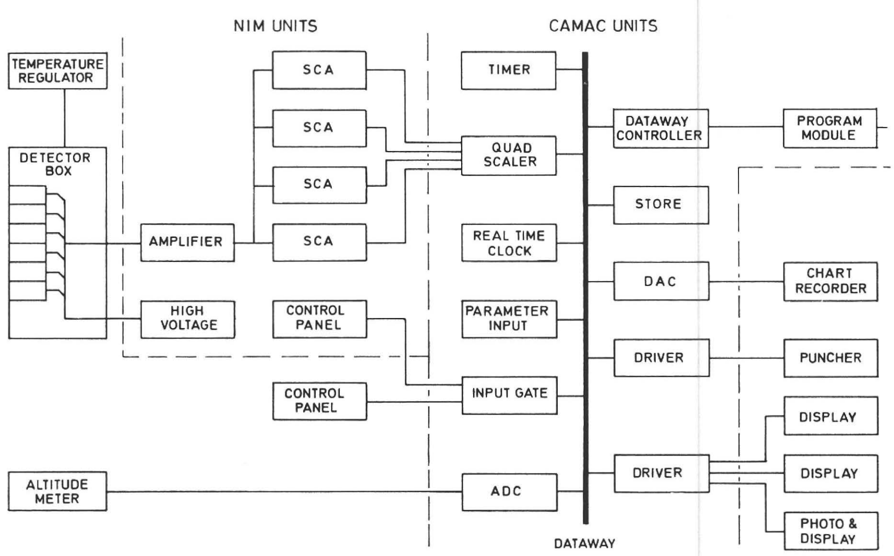

Fig. 2 Block diagram of the instrumentation.

The overflow landscape is photographed in conjunction with each measurement because only rather poor maps of this district are available. The display is reflected into each picture in order to give the time and altitude of a corresponding paper tape output.

The CAMAC system is controlled by the programmable dataway controller, which reads its program from plug-in units containing diode matrices.

EXAMPLE OF MEASURING PROGRAM

A typical measuring sequence will illustrate the use of the units. The measuring time is set by a switch on the front panel of the timer and is typically 1 or 2 sec. During that time the aircraft has moved about 50m and about 1000 counts have been accumulated in the total count channel.

After each measurement the contents of the scalers are transferred to the store, and a new measurement is started immediately. During this new measurement the counts from the previous one are read from the store to the paper tape punch, together with the altitude. After every 20 measurements the real time clock and some other parameters, e.g. flight number set on the parameter unit, are also punched out.

The counts from one of the scalers and the altitude are also transferred to the strip chart recorder. This gives the operator an immediate indication of significant changes in the radiation, and may help in choosing interesting areas for the flights.

The data from the measurements are on paper tape in a form suitable for later processing on a big computer.

INSTALLATION

Because of the environment in which this equipment is going to work, particular care in the installation is required. All screws that do not have to be unscrewed will be secured with locking resin. The crate will be mounted in the rack with extra fixing screws on the back of the crate. The rack itself will be fixed in the aircraft by means of four shock absorbers at the bottom and four at the top.

A special problem is temperature differences. The ambient day temperature may be 25 °C. the night temperature may be −5 °C. This gives a risk of condensed water, particularly as the system probably cannot be powered during the night. Water-absorbing units with silica gel will be placed in the system to minimize this problem.

CONCLUSION

The great advantage in using CAMAC is the flexibility of the system. The searches will go on for several years, and each summer's flights may call for reconfiguration and program changes. These can be made very easily. We hope that CAMAC will prove reliable under these unusual environmental conditions.

ESONE ANNOUNCEMENTS

AVAILABILITY OF EUR 4100 (1972), EUR 4600 AND EUR 5100 IN FRENCH, GERMAN AND ITALIAN

The official translations of the documents EUR 4100e (1972), EUR 4600e and EUR 5100e into French, German and Italian language are not yet available. These documents might be ready for distribution by the end of 1973. The existing copies of EUR 4100 in French, German and Italian are *not* the new edition of 1972. Translations into the Hungarian and Czechoslovakian languages are also planned.

INTERPRETATION OF EUR 4600e (1972)

Command Accepted (BX)

The generation of BX by Crate Controller Type A-1 is fully defined for Command Mode operations (Sections 4.2.3. and A1.8). It is not defined for Graded-L operations. These are generally multi-addressed, in which case the BX signal at the branch driver is an unreliable indication that all crates have responded to the operation. The Dataway Working Group therefore makes the following recommendations:

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

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

Dataway Inhibit (I)

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

— Crate Controller Type A-1 should generate I as at present defined in Sections A1.5.3 and A1.10 (and as shown in Fig. 7);

— any auxiliary means of generating commands in an off-line crate should conform to Section 5.5.2 of EUR 4100e (1972) by generating I = 1 in response to Z.S2. It should preferably maintain I = 1 and provide a means of resetting it.

HIGHLIGHTS OF THE ESONE GENERAL ASSEMBLY

JÜLICH, GERMANY — OCTOBER 1972

"Things are getting bigger" might well be the aphorism for the latest General Assembly of the ESONE Committee, and particularly if judged by numerical statistics as most things are these days. In reality, the Assembly served to summarise the current technical status and again Industrial Companies demonstrated a strong and growing interest in CAMAC and its wider diffusion into new applications.

The Assembly was very much an open forum for participation by Committee Members, company representatives and visitors in discussions at the open sessions and with company specialists at the exhibition. The Exhibition was provided by 31 CAMAC supply companies and their 78 representatives. Thus apart from the 62 ESONE Committee members or observers, this comprehensive exhibition also attracted 22 visitors from the Deutsche Studiengruppe für Nukleare Elektronik, 22 staff members of KFA Jülich and 18 other visitors from different parts of the world.

Such a huge conference required a perfect back-up organisation and an appropriate setting. Without any reservations, both were generously provided and it is proper to record appreciative thanks from all participants to the Directorate of Kernforschungsanlage, Jülich and to Dr. K. D. Müller and his very effective team.

One highlight may have gone unnoticed by many but was of great significance to Committee Members. This was the presence of a senior observer from the Commission of the European Communities (CEC) from whom the Committee has been seeking support for promotion of CAMAC in non-nuclear areas such as medicine, the environment, process-control, machine tools, etc.

An innovation on previous Assemblies was to arrange for Companies to present their products early in the Sessions so that the Exhibition was made more interesting. Companies were also invited to join in the next round of discussions with CEC and three representatives were appointed for this attempt to diversify CAMAC into new application fields.

The importance of the ESONE Committee's relationships with other organisations was made clear during the conference, particularly that with the International Electrotechnical Commission (IEC). A recommendation by Technical Committee No. 45 had been made that a new Working Group of that Committee should be set up to prepare IEC documents dealing with CAMAC. A document covering the mechanical features of CAMAC, NIM and USSR 20 mm modules was already in an advanced state and could become an IEC recommendation in 1973-74. Because CAMAC could be of interest to other TC's of IEC contacts with these were already being made by the ESONE and NIM Committee representatives.

The CAMAC Bulletin was reported as being quite a successful venture since more than 600 copies had already been subscribed and more subscriptions were arriving daily. Because of this, more logistic support can be expected for the preparation, publication and distribution of the Bulletin than is at present generously provided by CEC.

Several speakers from different geographical zones gave interesting reports concerning the uses of CAMAC in their respective zones. Perhaps the most surprising report was the planned large-scale application, in Poland, for the mining, ship-building and shipping industries and in power generating stations. The report from USA indicated that practically all the national AEC laboratories had now gone over to CAMAC.

The ESONE Committee endorsed the NIM Committee's paper on "Supplementary Information on the CAMAC Instrumentation System" (TID 25877). This document submitted by the Dataway Working Group includes recommendations and preferred practices and does not modify the CAMAC specifications. The Dataway Working Group also reported on the progress made in specifying a Serial CAMAC Branch which was of vital interest to many people.

As with any other developing organisation several changes were announced, for example, the appointment of Prof. R. Patzelt to replace Dr. K.D. Müller on the Executive Group, the appointment of Herr Friese to replace Dr. K. Tradowsky, who is leaving KFZ Karlsruhe, as Chairman of the Analogue Signal Working Group. New members from Oxford University, England and University of Alberta, Canada, were welcomed by the retiring Chairman (Dr. K.D. Müller) who is now replaced by Professor B. Rispoli of CNEN, Italy.

The next General Assembly was arranged for June 1973, to present at Risö, Denmark, recommendations from the Working Groups on the Serial Branch and CAMAC Languages. An Annual General Assembly with a Conference and Exhibition to take place beginning of December, in Luxembourg, was also tentatively included in the ESONE Calendar for 1973.

NEWS

CAMAC SEMINARS AT HARWELL

The next three-day Seminar on CAMAC will be held in October 1973, and early booking is recommended since all previous Seminars have been fully booked. Application forms are available from the Post-Graduate Education Centre, AERE Harwell, Berkshire, England. The lecturers are normally Messrs. R.C.M. Barnes, A. Lewis, L. Ward, I.N. Hooton and H. Bisby.

DEVELOPMENT ACTIVITIES

1

CAMAC SERIAL CRATE CONTROLLER

by

Edward Barsotti

National Accelerator Laboratory, Batavia, Illinois, U.S.A.

Received 14th June 1972

SUMMARY The National Accelerator Laboratory uses serial CAMAC systems to control experimental beam lines, including the two-mile long neutrino beam line. The paper describes a crate controller used on a serial branch highway, and compares it with an earlier scheme based on serial links to remote drivers for parallel branch highways.

INTRODUCTION

Since its conception, CAMAC has become a widely accepted method for interfacing computers to controlled devices. Because of this growth, the National Accelerator Laboratory chose a serial CAMAC control system for its experimental beam lines. The first attempt at serializing CAMAC was done throughout the two mile long Neutrino beam line. A branch driver was designed that accepted a 70-bit serial word and interfaced to commercially available Type A crate controllers conforming to CAMAC specifications. Due to excessive costs and the need for additional features, another serial system was designed for the Meson and Proton experimental beam lines. This system replaces the serial branch driver, branch terminator, branch highway cable and Type A crate controller with a serial crate controller. In addition to having all the features of a Type A-1 crate controller, the serial crate controller has a block transfer mode for high speed data acquisition. An additional feature allows several combinations of crates separated by long distances to be addressed simultaneously.

INITIAL SERIAL CONTROL SYSTEM

A block diagram of the initial serial control system is shown in Fig. 1. A computer is interfaced to a standard CAMAC branch by means of a parallel-to-serial converter, transmit and return data cables, data repeaters, and the serial to parallel hardware of the serial branch driver. Additional branches are accessed by 'branching' from the first data repeater.

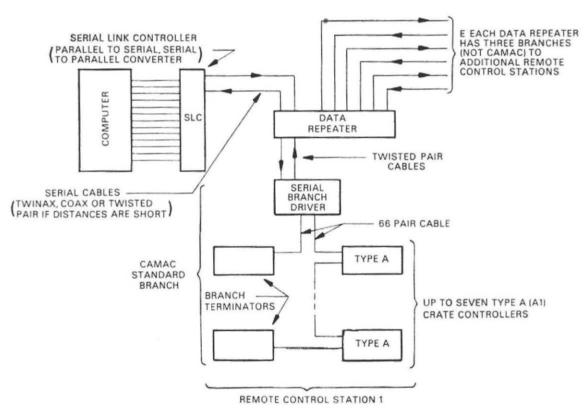

Fig. 1 Initial Serial System, with Crate Controllers Type A

Each data repeater allows branching to three remote control stations.

NEW SERIAL CONTROL SYSTEM

Fig. 2 shows a block diagram of the serial control system that uses the serial crate controller. The system is identical to the first system up to and including the data repeaters. Differential drivers and receivers are used to transmit and return the serial data from (to) the data repeater to (from) a serial crate controller. Several crate controllers may

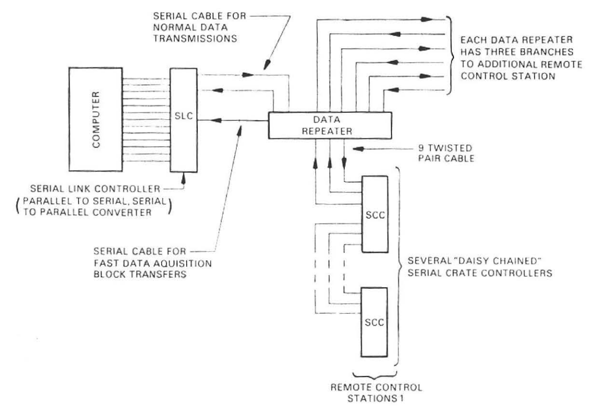

Fig. 2 New Serial System, with Serial Crate Controllers

be 'daisy-chained' at a remote control station. The method for branching off to remote areas is identical to that of the previous system. A third serial cable is used to return block transfer data to the fast access channel of a computer.

SERIAL CRATE CONTROLLER SPECIFICATIONS

Serial Word Interface

The data repeater accepts the high level 70-bit serial word, decodes it into a two phase clock and data, and transmits this information via TTL differential drivers and receivers to a serial crate controller. For each 70-bit transmission, the addressed serial crate controller returns a 35-bit word which includes 24 data, five status, and two parity bits.

CAMAC Dataway Interface

The serial crate controller contains all the features of a Type A-1 crate controller making it compatible with commercially available CAMAC modules.

Multi-Crate Commands

By setting a bit in the serial word, multi-crate commands are performed. These commands are used for simultaneously addressing modules in a predetermined block of crates or initializing all crates. Patching permits several different combinations of crates to be addressed by a series of multi-crate commands.

Block Transfers

Fast data acquisition is accomplished by using the serial crate controller block-transfer capabilities. This mode of operation was intended to be interfaced to a computer's fast access port. Reduced software overhead, and time savings by factors of ten to twenty, are two of the advantages of having the block-transfer feature. Dataway cycles required for block-transfer data occur only when a 70-bit word is not being transmitted through a crate, thus this mode does not slow down the normal serial system in any way.

The operation of this mode is as follows. A register in the crate controller is loaded with a function code (F_x), an initial slot (N_i), and a final slot (N_f). Dataway read cycles, interlaced with normal serial word cycles, are then generated, starting with the loaded function code, initial slot, and subaddress 0. Various address scan options are available, under the control of Q or X. Each dataway cycle returns a 28-bit word that includes 24 data, two status, and one parity bit.

COMPARISON OF INITIAL AND NEW SERIAL SYSTEM

Cost. Compared with the old system there is a cost-saving factor of between 2.7 (for a remote group of seven crates) and 3.3 (for a single remote crate). Hardware common to both systems is not included in these cost comparisons.

Testing/Maintenance. Both the serial branch driver and Type A-1 controller are double-width modules each having well over two hundred module-to-module or module-to-connector wires. Testing and maintenance of these modules are very difficult. The serial crate controller consists of three single width modules interconnected only via rear ITT Cannon connectors. One Lemo connector, four LED's, three switches, and 16 test points are included on the front panels of the three modules to simplify crate testing.

ACKNOWLEDGEMENTS

I would like to express my appreciation to Rod Wischermann for all the assistance given during the development of the serial crate controller.

NEWS

ANNOUNCEMENTS BY CAMAC MANUFACTURERS

WISSENSCHAFTLICHE DATENVERARBEITUNG GmbH (WDV) offers a large CAMAC interface system (WDV 3300) for the computer IBM 1130 with high-speed data channels for real-time data acquisition and data transmission. An interactive graphics controller together with a graphic display terminal with light pen and a graphic data sensor permit interactive graphics for man-machine 'on-line' communication.

Extensive software is available, compatible with the IBM 1130 Fortran compiler.

CAMAC interface systems for the computers IBM 1800, Honeywell, Univac, HP, Varian, Interdata, CII, PDP11, PDP8 etc. are also available on request.

PREPARATION OF CONTRIBUTIONS

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

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

◇2◇ A MODULAR CAMAC INTERFACE FOR THE VARIAN 620 COMPUTER

by

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Received 19th June 1972

SUMMARY This interface between the CAMAC branch highway and a Varian 620 computer consists of plug-in units in a standard CAMAC crate whose Dataway wiring is used as an Interface Highway. The modular construction allows the interface to be extended, for example to include a manual controller, or adapted for use with different computers.

GENERAL DESCRIPTION

A computer coupler for a CAMAC branch highway consists essentially of a branch driver linked to a computer interface. The coupler described in this paper is an assembly of plug-in units, including a branch driver and an interface to the computer, mounted in a standard CAMAC crate. Communication between these units is by means of an Interface Highway, making use of the Dataway wiring in the crate and is supervised by a Priority Unit at the Control Station.

Most lines in the interface highway are used in accordance with the definitions of Dataway lines in EUR 4100e. The coded station number is transferred from the computer interface to the branch driver by bus lines on the five patch contacts P1-P5, and the coded crate address is transferred on the C, I and B lines. The priority unit arbitrates between requests on the L lines, and assigns control by means of the N lines.

The strobe lines S1 and S2 are used for interface timing signals IA and IB. After control has been assigned by an N-line signal, the selected unit generates the command CNAF and, after a delay, the IA signal (corresponding to BTA). The addressed unit replies with IB, for example deriving it from BTB. The read data, Q and X signals are accepted in response to IB.

COMPUTER INTERFACE UNIT

This unit has been developed to couple the interface highway to a Varian 620 computer. It uses 5 of the 64 addresses on the I/0 bus. The 17-bit CNAF Command word is transferred from the computer in one operation by choosing the appropriate one of four I/0 addresses to indicate whether the crate address is in the range 1-4 or 5-8, and whether the data requires a single or double transfer. The fifth I/0 address is used for transferring the data.

Priority assignment is requested on the L line at the time of computer strobe FRYX. If control has not been assigned to the interface before the end of the computer operation it generates an interrupt, and the computer can repeat the I/0 operation. It is also possible to ask for priority by a computer EXC command, and to monitor the assignment by a SENS command. The Q and X values from the last branch operation can also be tested by SENS commands.

Other units can address the computer interface by means of crate address CR = 8. The A, F and coded station number lines are then used to transfer up to 14 bits of data, for example an interrupt address in a 32-word block of computer store, or the addresses in 4k of computer store for DMA TRAP IN and TRAP OUT.

BRANCH DRIVER UNIT

This unit couples the interface highway to a branch highway conforming to EUR 4600e. The branch operation can be halted at the stage (BTA = 1, BTB = 1), with the state of all branch lines indicated, and can be continued by pressing a button. If the operation is not completed correctly the branch driver generates an error interrupt to the computer (using crate address CR = 8).

When it receives a branch demand BD = 1, the branch driver requests priority via the L line. When priority has been assigned to the branch driver it performs a Graded L (BG) operation on the branch, selects the GL request with highest value, and sends the corresponding interrupt address to the computer interface (again using CR = 8).

PRIORITY UNIT

This is an executive controller occupying the control station in the crate. It accepts priority requests from other units via the L lines. At the end of the current operation, or immediately if there is no operation in progress, it assigns control to the highest priority request via the corresponding N line. The requesting unit removes the L signal when it receives N.

AUTOMATIC TRANSFER UNIT

When this unit has been enabled it initiates DMA transfers between any module in the branch and a block of computer memory locations. The module address and the first memory address have to be loaded into the transfer unit in advance. If the branch operation results in Q = 1, the data are transferred by DMA, and the DMA address is incremented by means of CR = 8 and the NAF lines. After each transfer the L signal is interrupted for a short time to allow other requests to be accepted.

MANUAL CONTROL UNIT

In its passive state this displays either the last command and corresponding data, Q and X, or the data corresponding to a preselected command. In its active state it can transfer a manually selected command and data, at rates of 100 kHz, 100 Hz or an external clock. The operation can be started manually or by an external signal, and can be completed or divided into two parts. The memory and interrupt addresses can also be controlled manually.

ESONE ANNOUNCEMENTS

SUPPLEMENTARY INFORMATION ON CAMAC INSTRUMENTATION

All Bulletin subscribers will receive with this issue a copy of the Supplement to Bulletin No. 6: 'Supplementary Information on CAMAC Instrumentation'.

The Supplement contains information to be used in conjunction with the CAMAC Specifications EUR 4100e (1972) or AEC Report TID-25875 and EUR 4600e (1972) or AEC Report TID-25876. It contains recommendations concerning the implementation and interpretation of the specifications and description of preferred practices and current applications. The contents do not modify the specifications referred to above.

Additional copies of the Supplement can be obtained from:

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

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

NEWS

ANNOUNCEMENTS BY CAMAC MANUFACTURERS

SAIP SCHLUMBERGER is offering two software packages for programming CAMAC systems containing a PDP11 computer and the SAIP Schlumberger ICP11 branch driver or DEC branch driver C11-A.

The first package, CAMPACK, is a set of I/O sub-routines for use in the assembly language PAL 11; they must be resident in the computer core; they are called with a macro-instruction followed by parameters.

There are 52 CAMPACK statements and they are compiled by means of the PAL11 assembler. The statements are 4-6 letter mnemonics. They allow all the necessary computer-branch driver operations for achieving all CAMAC operations. They also allow for programming of standard peripherals such as a teletype and an oscilloscope display. Moreover there is an assignment statement for naming of a station.

The other package CAMCONV is a conversational language for checking of I/O devices. (It contains no arithmetic statements). Programs are written and executed by the operator, who may also stop the program for making changes.

Variables may be declared and the CAMAC operation instructions are of the form Cx Ny Az Ft, where x, y, z, and t are integers. There are instructions for letting the program 'halt' in a waiting loop, both unconditional and depending on the Q-value. Furthermore there are several kinds of branching statements.

For operator communication there is an instruction for printing on teletype; if a LAM occurs, a message is printed. Error messages are printed too.

CAMCONV takes lk of the core space.

POWER ELECTRONICS (London) Ltd. have supplied power units (model SP426) for CAMAC use to Rutherford High Energy Lab. Didcot, England. Some specs. are:
Input: 100-125 V, 200-250 V; 50-60 Hz.
Output: +6 V/20 A, −6 V/15 A, ±24 V/2 A, 200 V/0.1 A (unstabilized)
Size: 19″ crate with 8 3/4″ height and 12″ depth.

IMHOF-BEDCO offers new CAMAC crates (empty, model IB/9905-5HV1; height: 5 U+1 U ventilation area = 6 U) and module parts as kits.

The crate is made by OSL, 4 Avenue du Château, 06, La Trinité and Imhof-Bedco have world selling rights with the exception of France and to CERN. The Imhof-Bedco version is supplied unassembled in kit form and does not include the fan mounting plate that is normally fitted as standard by OSL. This plate (part No. CAM/FM) is available as an optional accessory and will accept either 1, 2 or 3 Frilec fans type V-113-P or others of similar characteristics.

The crate is extremely rigid of machined construction that ensures easy and accurate assembly. A principle feature of the design is the detachable connector mounting which allows independent assembly of connectors or dataway.

Module parts are all to a new improved design and replace the original module kits offered by Imhof-Bedco. Single to quadruple-width units with short screen plates (CAM/M1A to CAM/M4A) and with long screen plates (CAM/M1B to CAM/M4B) are available as kits.

Features of the design include a much more rigid and accurate construction and the ability to remove the top-runner fixing screws to allow the bottom screws to act as a hinge pivot for accessibility. The ventilation area exceeds the CAMAC specification—18cm² on single modules, pro-rate on other sizes and is increased even further on treble and quadruple models if additional guides are not fitted.

BORER ELECTRONICS AG are providing a number of overlays to facilitate considerably the use of the Borer Type 1533 CAMAC Crate/PDP-11 Unibus Interface. The following are already available and further packages are in preparation:

— Single-user Basic;
— 8-user Basic;
— 8-user Basic with file handling;
— Fortran calls for CAMAC;
— RSX 11 with CAMAC (available shortly).

DISPOSITIFS SIMPLES POUR LA VISUALISATION DE DONNÉES NUMÉRIQUES

3

par

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Received 12th July 1972

SUMMARY The paper presents various simple methods of displaying digital data in CAMAC systems. These displays can be used with an on-line computer, or without a computer while setting-up an experiment preparatory to data taking. Some of these devices can also be used to implement automatic measuring systems with print-out of results.

INTRODUCTION

Les installations expérimentales de physique nucléaire comprennent souvent un grand nombre d'échelles de comptage dont la réalisation dans le système CAMAC est particulièrement avantageuse. Ces échelles fonctionnent généralement en code binaire pur pour faciliter les échanges avec le calculateur et sont souvent pour des raisons économiques, réalisées en tiroirs 1/25ᵉ, sans dispositif interne d'affichage de leur contenu. Or l'expérimentateur désire en général pouvoir suivre le contenu de certaines d'entre elles au moins pendant la phase de mise au point de son expérience, phase au cours de laquelle il ne peut ou ne désire pas disposer du calculateur. C'est pourquoi nous avons développé plusieurs éléments d'affichage de données numériques, peu onéreux, répondant à ces exigences :

— Un tiroir 1/25 d'affichage par connexion directe.
— Un tiroir 2/25 d'affichage décimal permettant, par l'intermédiaire du calculateur, l'affichage du contenu de n'importe quel registre d'une branche.
— Un tiroir autonome d'affichage et d'impression automatique de branche CAMAC.
— Un contrôleur de châssis autonome pour l'affichage et l'impression automatique.

Les deux derniers éléments peuvent être connectés directement à une imprimante parallèle SEDELEC TL21 ou par l'intermédiaire d'un tiroir 2/25ᵉ à une imprimante perforatrice Télétype ASR 33.

AFFICHAGE PAR CONNEXION DIRECTE

C'est évidemment la solution la plus simple consistant à relier directement par un câble externe l'échelle de comptage à un tiroir 1/25ᵉ comprenant 24 voyants repérés en binaire pur ou en BCD. Ce tiroir, de très faible coût, permet de visualiser en permanence, indépendamment du calculateur, le contenu de la seule échelle à laquelle il est connecté. Cependant, il impose sur chaque échelle des circuits et un connecteur de sortie des informations dont le coût n'est pas négligeable.

AFFICHAGE DÉCIMAL CENTRALISÉ SOUS CONTRÔLE DU CALCULATEUR

Ce tiroir CAMAC 2/25ᵉ, permettant l'affichage décimal en clair du contenu d'un registre quelconque dont l'adresse est choisie manuellement, ne peut être utilisé que dans une installation avec calculateur en ligne. L'opérateur affiche sur les commutateurs décimaux de ce tiroir, l'adresse $C_X N_Y A_Z$ du registre dont il veut visualiser le contenu (Fig. 1).

Le calculateur lit cette adresse par CNF(1) A(0), puis le contenu du registre $R = (C_X N_Y A_Z)$ situé à cette adresse. Après transcodage binaire BCD éventuel de R (par programme), il écrit cette nouvelle valeur $R'_{(10)} = R_{(10)}$ ou $R_{(2)}$ par CNF (16) A(0)

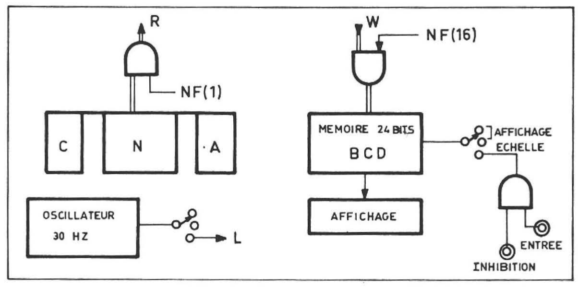

Fig. 1 Synoptique du tiroir d'affichage centralisé JAF-15

dans la mémoire d'affichage du tiroir. $R'_{(10)}$ apparaît en clair sur 6 indicateurs numériques électroluminescents.

Un oscillateur interne permet, lorsqu'il est en service, d'émettre un appel toutes les 30 ms indiquant au calculateur que la valeur affichée est à renouveler. L'opérateur peut ainsi suivre à chaque instant le contenu de n'importe quel registre de la branche. En outre, la mémoire d'affichage peut être utilisée en échelle de comptage 25 MHz à affichage direct.

TIROIR AUTONOME D'AFFICHAGE ET D'IMPRESSION AUTOMATIQUE DE BRANCHE

Ce tiroir, non standard CAMAC, placé dans une configuration standard de branche CAMAC est utilisé comme organe de gestion de branche spécialisé dans l'affichage des données numériques soit pour remplacer le calculateur lors de la mise au point de l'expérience physique soit pour constituer un ensemble autonome de mesures avec impression automatique.

Prenant la place du tiroir interface calculateur dans le châssis de commande de branche CCOB-10, il permet (Fig. 2) :

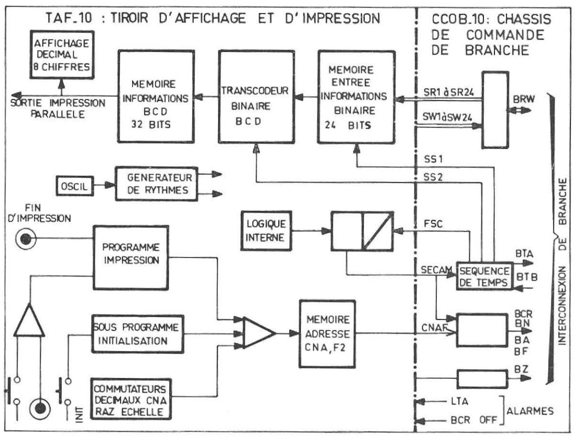

Fig. 2 Synoptique châssis CCOB-10 avec tiroir TAF-10

— L'affichage décimal sur 8 éléments électroluminescents du contenu d'un quelconque registre binaire CAMAC de 24 bits, dont l'adresse est choisie manuellement par des commutateurs décimaux.

— L'impression sur machine parallèle SEDELEC TL 21 du contenu de *n* tiroirs échelles binaires ($n \leqslant 20$) dans un ordre défini par un programme câblé interne.

Châssis de commande de branche CCOB-10

C'est un châssis autonome largeur 19″, hauteur 4U d'un emploi très général comportant tous les circuits de commande d'une branche CAMAC conforme au document EUR 4600 : séquence de temps BTA, BTB, émission de BZ, CNAF, BW, réception des BR, BD, BQ, BX; en outre, il possède des circuits de détection d'erreur d'adressage (à un châssis hors ligne) et limiteur de temps d'attente.

Il comporte un emplacement réservé pour un tiroir interface spécialisé en fonction du calculateur, ce qui permet de réduire les éléments à changer lors d'un changement de calculateur. Son utilisation est très simple : le tiroir interface doit simplement lui présenter en parallèle le mot CNAF et éventuellement les informations W puis un état de validation appelé SECAM.

Il fournit séquentiellement et en retour au tiroir interface les informations R, Q, X accompagnées d'un signal d'échantillonnage SS_1 (équivalent à S_1 dans un contrôleur de châssis) puis un signal SS_2 et un signal FSC, fin de séquence CAMAC.

Tiroir d'affichage et d'impression TAF-10

Ce tiroir comprend essentiellement trois fonctions :

a) Un programme câblé d'initialisation de la branche CAMAC, déclenché manuellement et effectuant successivement :
   - l'initialisation du châssis CCOB-10
   - l'initialisation de la branche BZ
   - la validation de la branche (autorisation de l'émission des commandes CAMAC)
   - la mise en service générale de tous les tiroirs par F(26) en multiadressage total de tiroirs et de châssis
   - la levée de l'inhibition permettant la mise en marche simultanée de toutes les échelles de comptage.

b) Des circuits pour l'émission des commandes de lecture CNAF(0)-CNAF(2) et l'affichage du contenu du registre adressé, comprenant en particulier une mémoire adresse $CNAF_2$ chargée par les commutateurs décimaux permettant de choisir l'échelle à visualiser une mémoire information 24-bits binaires R, un transcodeur binaire BCD séquentiel, une mémoire information BCD de 32 bits dont le contenu est affiché sur 8 éléments décimaux électroluminescents.

c) Un programme d'impression automatique de l'adresse et du contenu de 20 échelles dont l'ordre d'appel est défini par câblage de diodes sur une matrice. Un sous-programme spécialisé permet sur un seul pas de programme de lire 4 échelles situées à des sous-adresses A_0 à A_3 dans un seul tiroir.
   Ce tiroir se connecte directement à l'imprimante parallèle SEDELEC TL21 ou par l'intermédiaire d'un tiroir CAMAC 2/25[e] à la Télétype ASR 33.

TIROIR CONTRÔLEUR DE CHÂSSIS POUR L'AFFICHAGE ET L'IMPRESSION JCAFI-10

Bien que très semblable au TAF 10 dans sa conception, ce tiroir répond à des utilisations plus larges. Il permet, en effet, comme le TAF 10, la mise au point des expériences avant le couplage de l'installation au calculateur, mais il doit surtout permettre de réaliser en standard CAMAC les nombreuses petites installations de mesures de laboratoires ou de mesures industrielles pour lesquelles un calculateur ne présente aucun intérêt compte tenu de son coût ou du temps nécessaire à l'écriture des programmes. Les nombreux avantages du standard CAMAC : choix et diffusion des appareils, facilité de maintenance, facilité d'adaptation à des appareils extérieurs, doivent en effet permettre de réaliser ces petites installations dans des conditions économiques très voisines de celles des réalisations habituelles « à la demande ».

Ce tiroir, conforme au document EUR 4100 (72), permet l'affichage en décimal et l'impression automatique du contenu des registres binaires ou BCD, l'utilisation de la réponse Q dans les modes Address Scan ou Bloc.

CONCLUSION

Nous avons présenté ici quelques solutions simples et peu onéreuses pour l'affichage numérique du contenu de registres CAMAC, en particulier des échelles de comptage, dans des ensembles connectés ou non à un calculateur, en ignorant volontairement les systèmes de visualisation sur tube de télévision, reliés au calculateur directement ou par l'intermédiaire du CAMAC, systèmes dont la puissance, mais aussi le prix, n'ont évidemment rien de commun avec les tiroirs décrits ci-dessus.

SOFTWARE

CAMAC OVERLAY FOR SINGLE-USER BASIC AND MODIFICATION OF 8-USER BASIC FOR THE PDP-11

by

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Zentrallabor für Elektronik der KFA Jülich GmbH, Germany

Received 3rd July 1972

SUMMARY This paper shows the construction of a simple BASIC I/O handler to be used with the Jülich CAMAC/PDP-11 system. A simple format has been chosen, so that a system can be set up by users who are not familiar with assembler programming.

INTRODUCTION

An interpretive language[1] like BASIC is useful for test routines and non-time-critical experiments. It is easy to learn, programs can be changed and corrected easily, and the execution of single commands is possible. During recent years BASIC has become more or less a standard language for mini-computers (though other languages such as FOCAL have some advantages) and many programs are available. High level languages on small computers are extremely useful for users who are interested in getting results rather than in programming.

A CAMAC I/O handler was therefore developed for use with the two versions of BASIC on the PDP-11, in conjunction with the Crate-System-Controller (CSC11) developed at Jülich[2].

The DEC single-user-BASIC[3] is a simple version of BASIC, capable of working in 4k memory or more. Due to its construction, using traps and a traphandler routine instead of sub-routines, it is slow. This version is used only for one-crate CAMAC systems with a small memory. The CAMAC I/O handler is fully compatible with the 'external function' (EXF) provided by DEC. A parameter set following the EXF statement holds the NAF and data information. After loading the single-user BASIC, the Overlay is loaded and BASIC is started automatically. Then the statements can be given as single statements executed immediately or can be written into the text buffer (preceded by a line number) to set up a program.

The Eight-User-Basic[4] uses sub-routines instead of traps. With its advanced I/O routines it is much faster than single-user BASIC. Up to eight users are able to write and run their routines simultaneously, sharing peripherals. Therefore up to eight experiments could be run simultaneously. For this version the useful minimum is 16k of core memory. The CAMAC I/O handler has been inserted in the BASIC source program and the combination has been assembled as an entity. This version is used for several experiments.

FORMAT OF THE CAMAC INSTRUCTION

Before describing the details we would like to make some general remarks. Each complete BASIC instruction is stored in a working buffer immediately after typing carriage return (CR). If there is a line number (decimal) preceding the statement this number is used to locate the line within a program and the line is transferred into the text buffer after CR. At the same time the BASIC statement (LET, PRINT etc.) is checked against a command list and is represented by a number when correct (for core efficiency). When the program is started by the RUN command, the statements are executed sequentially. A command without a line-number is executed immediately after typing CR (immediate mode).

Format for Single-User-BASIC

DEC defines the function EXF (parameter set) as an Overlay function. To meet the demands of the format a dummy statement has to be written.

(Line number) $\underbrace{\text{LET U = EXF}}_{\text{dummy}}$ (M, N, A, F, D) CR.

Different EXF functions can be distinguished by the first character (M) of the parameter set, as following:

M = 0 Commands to modules, with parameters:
- N = Station number,
- F = Function Code,
- A = Subaddress,
- D = Data variable (if F8 = 0).

M = 1 Clear

M = 2 Initialise — Commands to 'Common

M = 3 Set Inhibit — Control' signals.

M = 4 Reset Inhibit

All the parameters are variables or decimal numbers. For example, the following statements write the number 1000 into subaddress 0 of Stations N = 3 to N = 10:

```
100 FOR N = 3 TO 10
110 LET U  = EXF (0, N, 0, 16, 1000)
120 NEXT N.
```

Q response is used as a logical variable (= 0 or 1) and is automatically set in dataless commands to be used for decisions.

Format for Eight-User BASIC

The following CAMAC statements are incorporated in the command list.

CAMAC Command	Parameters	Carriage Return	Comment
CZ	C	CR	Initialise Crate C
CC	C	CR	Clear Crate C
CIS	C	CR	Set Inhibit Crate C
CIR	C	CR	Reset Inhibit Crate C
CF	F, C, N, A	CR	Datal ess commands
CR	F, C, N, A, D	CR	Read data from CAMAC module N
CW	F, C, N, A, D	CR	Write data into CAMAC module N

All these parameters are variables or decimal numbers. Response Q again is used automatically as a logical variable.

An example of a program listing in this format is given below:

```
1 REM PROGRAM TO DISPLAY SIN(K*X)*EXP(-M*X) USING TEK 611
2 REM AND CAMAC SEN DISPLAY-UNITS
5 CZ 2                                  :REM INITIALISE
10 CIR 2                                :REM INHIBIT RESET
20 CF 28,2,4,0                          :REM ERASE 611
30 CF 26,2,4,0                          :REM SET STORE MODE
40 CF 28,2,1,0                          :REM INIT LOADING LOGIC
50 CW 16,2,1,0,3                        :REM SET INTENSITY
60 CW 16,2,1,1,2                        :REM Y VERS. X FINE
70 PRINT "AMPLITUDE";:INPUT K
75 PRINT "TIME-BASE";:INPUT M
78 PRINT "DAMPING-FACTOR";:INPUT N
80 FOR I=0 TO 1023                      :REM # OF POINTS
85 LET U=K*SIN(I/M)*EXP(-I/N)+500       :REM FUNCTION
90 CW 17,2,1,0,U                        :REM WRITE Y
100 NEXT I
110 END
READY
```

LINKAGES TO BASIC

Single-User BASIC

The DEC specifications are used i.e., the overlay start address is written into location 50, and location 52 holds the jump-back address to BASIC. The first character-parameter of the set is used to distinguish between the different routines. The evaluation of the parameters uses routines similar to those described below for eight-user BASIC. This is also true for format routines and setting of Q response.

Eight-User BASIC

Here the commands have been added to the BASIC command list. The parameter evaluation uses internal BASIC routines and is therefore extremely short and simple. Register R1 is used as the text buffer pointer. All handler routines jump back to label INIT 02 in the interpreter routine[A]. (Letters refer to listing).

As an example, the procedure for executing the command CF 8, 1, 3, Ø will be explained. When CF is recognized the pointer R1 points to 8 (which also could be a BASIC variable). Statement JSR, PC, EVALØØ calls the evaluation routine and this routine delivers the value of the parameter in floating point format (registers R2, R3, R4). With JSR PC, FIXØØ[B] this floating point number is converted to a 16-bit fixed binary in register RØ. When the parameter is an expression like (2A+B 3) it is only necessary for R1 to point to the first character. When the first parameter is evaluated R1 points to the separating comma, and must be incremented to point to the second parameter. The evaluated parameters are used to set up the CAMAC address etc.[C]

To write data into CAMAC the handler has to convert the floating point format to a 24-bit integer. This is done by shifting the floating point mantissa until the least significant bit reaches the right-most position of the low order word[D]. Then the 24-bit word is transferred to CAMAC in two steps[E].

When CAMAC words are read, the handler converts the 24-bit word to a floating point number, which is normalised using the internal normalise-routine[F]. The association of the normalised floating point number with the specified variable is done by the internal get-address routine (GTDR) which delivers the variable pointer in RØ[G].

Q response is set by pointing to a location holding the ASCII value of Q (QSIGN) with the variable-pointer[H].

When a command is sent to a non-existing CAMAC crate the time-out trap operates and the message 'NON EXISTING DEVICE' is printed.

Listing

```
CIS00:      JSR   PC,EVAL00         ;CALL EVALUATE-ROUTINE
            JSR   PC,FIX00          ;CALL FP TO FIX-ROUTINE
A)          ASL   R0                ;*2
            MOV   #200,@CCSR(R0)    ;SET INHIBIT
            JMP   INIT02            ;JUMP BACK TO BASIC

            JSR   PC,EVAL00         ;EVAL.F AS FLOATING-POINT
B)          JSR   PC,FIX00          ;F AS INTEGER IN R0
            MOV   R0,FUNC           ;STORE F IN FUNC
            INC   R1                ;INCREMENT POINTER

            JSR   PC,EVAL00         ;GET CRATE-ADDRESS
            JSR   PC,FIX00          ;IN R0
            ASL   R0                ;RIGHT POSITION
            MOV   CAMA(R0),ADDR     ;SET UP BASE-ADDRESS
            MOV   CCSR(R0),CSR      ;SET UP CONTROL-REG.
            INC   R1
            JSR   PC,EVAL00         ;GET N
            JSR   PC,FIX00
            ASL   R0
C)          ASL   R0
            ASL   R0
            ASL   R0
            ASL   R0                ;INTO RIGHT POSITION
            BIS   R0,ADDR           ;OR IT TO BASE
            INC   R1
            JSR   PC,EVAL00         ;GET A
            JSR   PC,FIX00
            ASL   R0                ;RIGHT POSITION
            BIS   R0,ADDR           ;CAMAC-ADDRESS IS SET UP

            JSR   PC,EVAL00         ;GET VALUE
            SUB   #100037,R4        ;COUNTER FOR SHIFT
            NEG   R4
D)          BEQ   CW02
            ASR   R3
            ROR   R2                ;SHIFT 2 WORDS
            DEC   R4                ;DECREMENT COUNTER
            BEQ   CW02              ;FINISHED

            BIS   FUNC,@CSR         ;STORE F
            MOV   CSR,HOW           ;GET BASE
E)          BIS   #10,HOW           ;FORM HIGH-ORDER ADDRESS
            MOV   R3,@HOW           ;WRITE 8 BITS INTO CSC11
            MOV   R2,@ADDR          ;WRITE 24 BITS INTO CAMAC

            MOV   DOWN,(R0)+        ;LOW-ORDER TO POINTERADDR.
            MOV   UP,(R0)+          ;HIGH-O.TO P.-ADDR.
F)          MOV   #100037,(R0)      ;FLOATING-POINT EXP.
            CMP   -(R0),-(R0)       ;SET BACK POINTER
            MOV   R1,SURE           ;SAVE R1
            MOV   R0,R1             ;GET POINTER
            JSR   PC,NORM00         ;NORMALISE FP.

            JSR   PC,GTDR00         ;GET VARIABLE-ADDRESS
G)          BNE   CF01              ;DOES NOT EXIST,SET UP
            MOV   R4,R0             ;GET POINTER
            JSR   PC,PSH00          ;VARIABLE IS SET UP

            MOV   R1,SAVE           ;SAVE R1
            MOV   #QSIGN,R1         ;FAKE VAR. Q
            BIT   #400,@CSR         ;TEST Q
H)          BNE   CF02              ;BRANCH IF 1
            CLR   DOWN
            CLR   UP                ;SET UP 0
            BR    READIN            ;SET VARIABLE
            MOV   #1,DOWN           ;SET UP 1
            CLR   UP
            BR    READIN
```

In the future a real-time clock and DEC-tape will be handled by our BASIC extension and at least the eight-user BASIC will be changed to work under the Disk Operating System (DOS). This advanced system will be capable of general file handling and will be used at the KFA Jülich as an operating system for controlling up to six experiments.

HANDLING OF INTERRUPTS

Assembler routines incorporated in the BASIC program are able to handle time-critical interrupts. In the KFA system the LAM's of the modules generate directly an interrupt vector which points to the first instruction of the sub-routine.

To build a system which allows BASIC programming of the interrupt routines, software-switches must be set when the interrupts occur. When the current line is finished the next line number depends on the source of the interrupt. When the interrupt routine is finished the program returns to the line after the interrupted line. This procedure is complicated if there is more than one user, because the interrupt has to set the software-switch in the appropriate user field.

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NEWS

DIALOGUE ON CAMAC-DEVELOPMENTS BETWEEN CNEN AND KFK

At the invitation of the Comitato Nazionale per l'Energia Nucleare, a delegation from the Laboratory of Electronics and Measurement of the Kernforschungszentrum Karlsruhe met a group of scientists from the Laboratori Nazionali di Frascati, the Centro Studi Nucleari Casaccia and the Instituto di Fisica di Roma, on 22nd and 23rd June 1972 at the CNEN Headquarters in Rome.

The participants gave reviews of their CAMAC activities and, in the detailed discussions which followed, fields of common interests were identified.

It was proposed that the further exchange of information on CAMAC development and application should be intensified and recently published papers should be exchanged to keep each side up-to-date on current work with CAMAC.

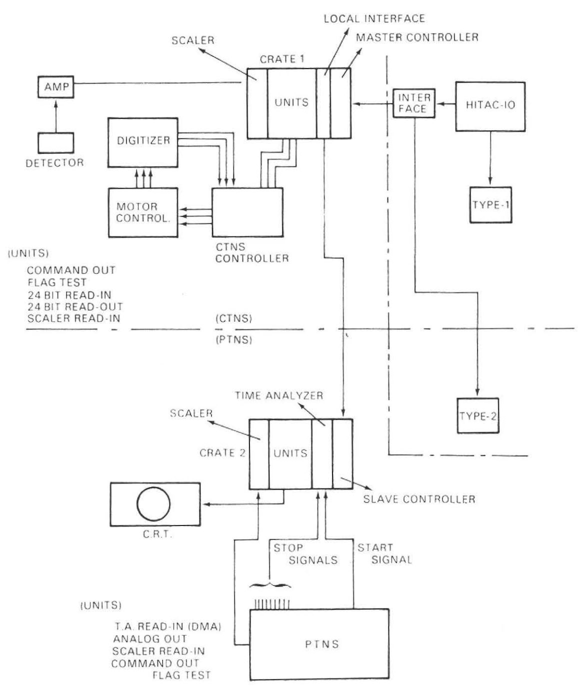
Some principal topics during the very fruitful discussions were:

- The exchange of experience in collaborating with the Industry on constructing new devices.
- Problems of software handling in growing hardware systems.
- Questions of data transfer over long distances.
- Performance of the Karlsruhe-developed Scaler-Timer-System with reference to the need to balance the costs for hardware and software.
- Performance of the Casaccia data link for data transfer between the main computer and remote processors.

NEUTRON SPECTROMETER SYSTEM WITH CAMAC IN JAPAN

A report received from Mr. S. Kinbara, Chief of Electronics at the Tokai Research Establishment, Japan, describes the use of an HITAC-10 (HITACHI Co.) 16-bit computer, interfaced by CAMAC, for the control and data acquisition of two neutron spectrometers. Two crates are employed; one is local to the computer and one spectrometer and acts as a master for the second crate at the remote spectrometer. These have been operating since October, 1971, and the CAMAC units are based on the Harwell 7000 Series.

The success achieved has awakened increasing interest in CAMAC and three or four new applications will be implemented during 1973.



Block diagram of the Neutron spectrometer system.

2

A CAMAC EXTENSION TO THE ASSEMBLY LANGUAGE FOR THE CII 90-10 COMPUTER

by

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Received 4th October 1972

SUMMARY Modifications to the assembly language of the CII 90-10 computer allow symbolic coding of CAMAC instructions. In order to achieve some hardware relocatability other components of the basic software (link-editor, monitor) have also been adapted for CAMAC programming. Some features of this work could easily be used with other computers.

INTRODUCTION

This paper describes an approach to introducing CAMAC instructions into an existing assembler on a small real-time computer used for data acquisition and handling in high energy physics experiments. This approach is aimed at allowing simple symbolic programming of CAMAC modules with two main features:

— Easy modification of the positions of the various modules in different crates is possible. This will referred to as 'hardware relocation';

— As far as possible the use of CAMAC with this computer should not increase the execution time, nor require more memory cells than the use of a previously designed interface optimized for this computer.

Hardware relocation appears to be a very important feature, especially during the whole building-up and testing phase of an experiment.

First there is a brief survey of the main characteristics of the computer, particularly of the input-output operations, as well as of some hardware solutions included in the design of the CAMAC system controller. Afterwards, there is a description of the modifications to the assembler, link-editor loader and monitor.

COMPUTER CHARACTERISTICS

The CII 90-10 (originally SDS 92) is a 12-bit computer. The configuration actually used in each of our five experiments is the following:

— 16 k words core storage;

— 1 magnetic disc unit (2M words);

— 1 magnetic tape used to output data for further treatment on a big computer;

— 1 teletype;

— 1 graphical (hardware) and alphanumeric (software) display;

— 1 input-output channel connected to the real-time interface;

— 16 interrupt levels.

Most instructions are double-word instructions in which the first word contains: 6 bits for the operation code, 3 bits defining the addressing mode (indirect, indexed or 'scratch pad'—special addressing for single word instructions), and the 3 high-order bits of the operand address. The second word holds the 12 low-order bits of this address.

In the set of 64 codes of the CPU, 4 are input-output codes. Two of them are action codes, EOM (energize output media), the other two are test codes, SES (sence external signal) which copy the status of some external flag (which may be the Q line for instance) into an internal flag.

During execution of one of these instructions, the 15 bits of the effective address of the 'operand' (i.e. the fully-computed address as indicated by the 3 addressing mode bits) are output on 15 external lines; special function lines give 2 additional bits of information coming from the operation code. A typical coding sequence for a single word (12 bits) transfer is:

output		input	
EOM	DEV	EOM	DEV
POT	M	PIN	M

DEV stands for the address of the external device, while M is the core location from or to which the word is transferred. The instructions PIN and POT are, respectively, parallel input and parallel output. In the case of block transfers these are replaced by BPI or BPO (block parallel input or output). For a 24-bit data transfer a special extension register must be used and the coding sequence becomes:

EXT	(special EOM with extension register address)
POT	M
EOM	DEV
POT	M+1

Control commands are performed by a single EOM or SES instruction.

Thus it can be seen that, in the general case, the transfer of a 12-bit word requires 2 instructions, i.e. 4 computer words.

As the same instructions are used to activate the standard peripherals, not all the 17 (15+2) bits are available for addressing the CAMAC interface. Actually only 16 bits are available, plus 8 single-word EOM instructions which are used for special purposes in the system controller.

CAMAC SYSTEM CHARACTERISTICS

The CAMAC interface consists of a system controller that interfaces the computer to the CAMAC system. It is able to drive up to 32 CAMAC crates. The total number of address bits required for the CNAF is:

$$C+N+A+F = 5+5+4+5 = 19 \text{ bits.}$$

It can be seen that the full adressing requires 19 bits and only 16 are available in the program sequences described above. The required number of bits has been reduced to 16 in the following way: the bits F_4, A_8 and C_{16} are assumed to be 0 in the short addressing form: the 16 standard CAMAC functions can then be programmed over the 16 low-number crates and the 8 lower sub-addresses.

If some non-standard function is to be used, the previous program sequences must be preceded by a special single-word EOM instruction (SF4) which sets the bit F4 in a special flag of the system controller, without generating any CAMAC cycle. This bit is automatically reset at the end of the following CAMAC cycle, during which the system controller generates the full CNAF. The same procedure is applied to the bits A_8 and C_{16}. In the worst case, the minimum program sequence may be preceded by the three single-word instructions: SF4, SC16 and SA8. In this case the sequence required to transfer one single 12 bit-word is increased from 4 to 7 memory locations. Block transfer is achieved by using non-standard read or write functions and the HOLD feature as defined by CERN[1].

Four other single-word EOMs are used in the system controller to perform special CAMAC functions: initialize, clear, set or reset inhibit.

ASSEMBLER MODIFICATIONS

First, 32 new mnemonics, corresponding to the 32 CAMAC functions, were added to the standard ones of the assembler. For non-standard functions, macro-generation was introduced, in order to generate the SF4 code automatically.

At this stage, explicit addressing (i.e. expressing the CNA as a 12-bit octal number) is possible, although rather tedious. If such a programming method is used, the double word instruction generated will look something like this:

OP	O	O	O	O	OP	O	O	X	Fn

C	N	A

OP, OP represent the 2 actual operation code bits

Fn represents the CAMAC function to be performed

X represents possible indexing (the index value is subtracted from the CNA value at execution time).

With explicit addressing the instructions SA8 and SC16 will also be macro-generated if necessary.

But the most interesting feature is the introduction of symbolic CAMAC address coding, in order to allow easy hardware relocation.

This relocation is limited by the need to change SA8 and SC16; a module cannot be transferred from the first group of 16 crates to the second without the corresponding programs being corrected and re-assembled. The same occurs with sub-addresses exceeding 7, but in general this does not affect the relocatability of the system, as the sub-addresses are fixed by the structure of the module.

The symbolic coding is achieved by giving some symbolic name either to a module (CN), or to a sub-address in the module (CNA), and by using this name as the operand in the CAMAC instructions. The numerical value of this symbol is not known by the assembler, which must therefore deal with it in almost the same way as for software external references. The latter are indicated to the assembler by a special directive (REF). A new directive has been introduced: RED (CAMAC reference). In the case of a REF, the assembler links all the instructions of the subroutine in which the same symbolic name appears, putting the address of the next link in the 15 bits of each instruction.

At the end of the binary object program the assembler generates a special item for each REF, containing the BCD symbolic name and the address of the last link of the chain.

During loading, the link-editor will satisfy the external REFs by external definitions (DEF) found in other program modules.

The same is done with RECs. But some trouble arises from the fact that the 15 address bits are needed for linking, while the 3 high order bits carry the CAMAC function. So the assembler does not generate the actual execution code, as it does in case of explicit addressing, but a sort of 'pseudo-code', rearranging the bits inside the instruction in the following way:

OP	Fn		OP		X	AD1
		1		2	3	

AD2

AD1 and AD2 represent the two parts of the linking address. The pseudo-code generated no longer looks like an EOM or SES instruction, in which the 3 Fn bits are zero. This does not matter, because the code is corrected before execution, as will be seen below. The REC directive also generates a special item with the BCD name and last link address. A special control word distinguishes REF items from REC ones.

As can be seen in the diagram, 3 bits are unused in this intermediate form if indirect addressing is prohibited in CAMAC instructions: one in the pseudo-code, and two bits of the addressing mode. They must be 0 at execution time but can be used in the intermediate form. In these 3 bits a constant ranging from 0 to 7 can be written, which will later be added to the CNA value found in the special CAMAC table (see below).

As an example: to read a group 1 register located at sub-address 7 in some module called SCAL, whose CN is defined in the CAMAC table, one can simply write:

REC SCAL
RD1 SCAL, , 7

In this form the constant 7 will be written in the 3 unused bits. An alternative method consists of defining in the table a 'label' entry, say SCAL 7, for the sub-address 7 of module SCAL and writing:

REC SCAL7
RD1 SCAL7

The various subroutines constituting the whole task are assembled in this way and generally output in a binary file on dics storage. Some experiments may require up to 50 or 100 subroutines, representing about 30-40 k words of program. An overlay structure with swapping between disc storage during execution is used in such cases.

LINK-EDITOR MODIFICATION

When all subroutines have been assembled, they are normally loaded from disc into core storage by a link-editor which relocates the various subroutines and satisfies external references either by finding the corresponding DEF in other user-modules or by making a library search to load the required subroutines.

When overlay structure is used, all the programs cannot be loaded simultaneously in core storage, and the absolute programs obtained by loading the various sections of the job are dumped one after the other in a special file on disc.

In all cases (overlay or not) an absolute image of the core storage is dumped in the absolute file of the disc, in order to avoid a loss of time when further execution is required.

The only modification introduced in the link-editor is that it is made almost transparent to RECs. Neither the operation code, nor the address part of CAMAC instructions are modified by the link-editor. It has only one action on RECs: if several subroutines refer to the same REC, the link-editor links the several chains together. Only one REC item is then maintained, which is afterwards output together with the absolute binary image in the absolute file on disc.

CAMAC DESCRIPTION TABLE

Independently of the various programs previously assembled, a CAMAC description table is constituted on disc, by means of a special conversational program. This table is unique for a given interface and is used by all the programs dealing with the same data acquisition system.

It is structured in two addressing levels: modules and sub-addresses. For each module entry the table contains: the symbolic name of the module (up to 8 characters), and the C and the N values defining its position. A special bit indicates that the entry corresponds to a module. Immediately after a module entry, one can find as many 'label' entries or sub-address names as necessary (or none). For each label the table contains: its symbolic name, a special bit indicating that the entry is a label, and its sub-address A.

Two remarks can be made. Only the 4 lower bits of C and the 3 lower bits of A are really useful. The full address is nevertheless kept in the table. This can allow error diagnosis in a more sophisticated system if the corresponding SC16 or SA8 instructions are missing. A module entry in the table can be considered as a sub-address label with the same CN and A = 0.

In each label entry 3 bits are reserved to indicate the 'type' of the label (0 to7). This feature is used for some particular modules, for instance when a group of modules or sub-addresses is treated as an array.

A specially written program allows easy generation or updating of the table, using the teletype as input device, and the alphanumeric display as output.

Updating the table is made very easy by its structure. When the position of a module is changed, only one entry of the table requires updating (the entry containing the CN portion of the CAMAC address) whatever the number of sub-addresses effectively used inside the module.

Another general remark can be made: by separating the CAMAC function completely from the CAMAC address, the size of this table can be kept within acceptable limits even for systems with a rather large number of modules.

MONITOR MODIFICATION

When execution of a program is required, the user calls for the monitor, and simply indicates to it the name given to the program in the absolute file on disc. When the program contains no CAMAC RECs, the monitor reads the absolute program into core storage, and if overlay is used, transfers the different non-resident sections into a special working file on disc, also used for program swapping during execution.

If CAMAC RECs are used, the monitor must search in the CAMAC table for the required REC, extract from the table the CNA value, add to it the numerical value contained in the pseudo-instruction, extract the linking address from the instruction, transfer the function code bits into the proper place, and clear the temporarily used function and sub-address bits in the pseudo-instruction.

The pseudo-instruction has now taken the same form (execution form) as if direct addressing was used.

CONCLUSION

Such an operating system has proved to be very useful during the development of experiments. At that time the positions of modules are often changed, especially before all the hardware is operational, when some components such as controllers are missing, or when special modules are under construction. The assembling and loading of overlay programs on small computers can take more time and require more computer knowledge than can be asked from a non-specialist user; no special knowledge is required for updating the CAMAC table.

Another advantage of the system is that the updating of one single table automatically updates all the various tests or acquisition programs dealing with the same interface.

This result can only be achieved by keeping the symbolic names of CAMAC modules all along the chain, from symbolic source program to absolute core image. Only in the last step before execution, can the correspondance with numerical values be achieved.

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A FOCAL INTERRUPT HANDLER FOR CAMAC

by

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Received 25th September 1972

SUMMARY A previously-described overlay program (FOCADAT) allows the FOCAL language to be used for handling CAMAC data and commands. This has been extended by the FOCALINT program to handle CAMAC interrupts. In this way FOCAL has been used in large control systems and also for testing CAMAC modules.

INTRODUCTION

There have recently been many attempts at developing a powerful real-time programming language. The authors believe that the system described here has many applications, both now and in the future.

The FOCAL overlay program FOCADAT[1] generates CAMAC commands and handles data transfers, but does not allow CAMAC to interrupt the computer. It has now been extended by a new program FOCALINT, so that CAMAC can generate up to 72 different interrupts. The CAMAC instructions available in FOCADAT and FOCALINT are summarised at the end of this paper.

The overlay can be loaded on any PDP8 type computer including PDP12 when running in 8-mode. It has been written for a crate controller and interface system for PDP8 machines which have been developed at Seibersdorf[2]. In this case the instructions *9,c and *10,c have the meaning of a general CAMAC interrupt off and on for all connected crates (up to seven crates). In addition to FOCALINT, an automatic power fail routine and the possibility of entering PAL routines by FNEW have been added. In this way FOCAL becomes a powerful program-system for testing and control purposes for CAMAC.

SYSTEM DESCRIPTION

The FOCALINT (FOCAL INTerrupt handler for CAMAC) is a general purpose system program which can be adapted for special use.

Up to 24×3 $(=72)$ interrupts with different meanings can be handled by FOCALINT. For each interrupt one program line number is reserved in group 31. of FOCAL. Thus a line is available for each module in up to three crates. The line numbers 31.01 to 31.24 are assigned to the first crate and the numbers 31.31 to 31.54 and 31.61 to 31.84 are assigned to the second and third crate respectively. (All other line numbers are free for other uses.) To obtain the special line numbers, a PAL routine forms the sum $31.00+N$ ($N =$ module number 1-24) for the first crate and does the corresponding operation for the second and third crate. If a module is able to generate more than one interrupt, further search routines can be executed by FOCAL subroutines.

Short servicing routines for interrupts can be typed into these special reserved lines, otherwise FOCAL subroutines can be used. Any statement which is specified by FOCAL, FOCADAT or FOCALINT is available for this purpose (i.e. DO, GO TO, IF, CAMAC statements, etc.).

If a CAMAC interrupt occurs during the execution of a line of the background program, the system prepares to enter the corresponding special line, but the current line will be continued. At the end of this line the program will enter the interrupt program. After execution, the program will return automatically to the next line of the background program where it has been interrupted (see Fig. 1).

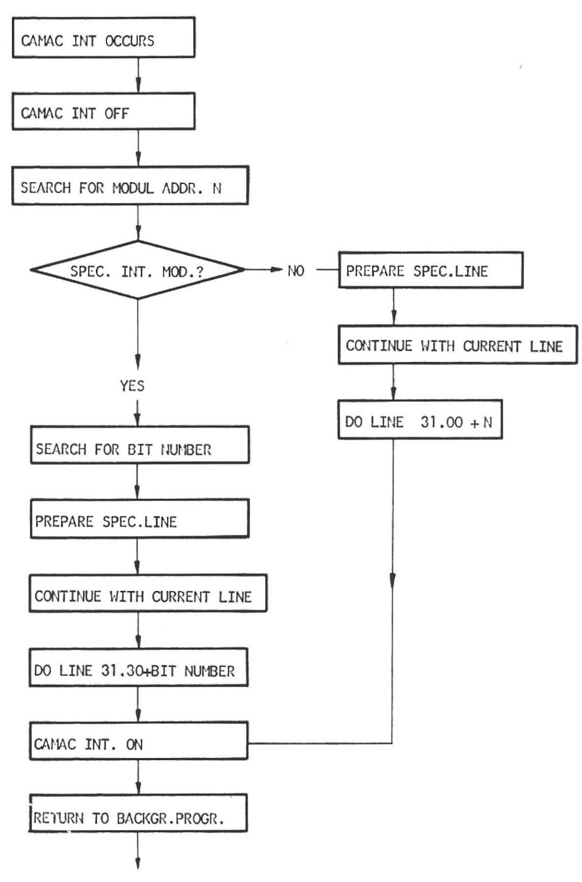


Fig. 1 CAMAC Interrupt Handler for 8 k (Example: 1 Crate, 1 Special Interrupt Module)

If a module is able to generate more than, say, 3-4 interrupts with different meanings, it can be declared as a 'special interrupt module', with up to 24 interrupts. This special interrupt module has to be plugged into the first crate. The reserved interrupt

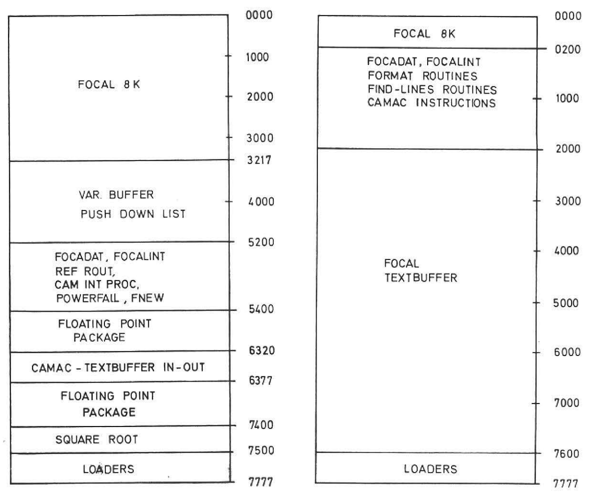
*Now with Österr. Verbundgesellschaft.
**Now with Kernforschungsanlage Jülich.

lines for the third crate are now assigned to this interrupt module. The corresponding line numbers are found by a PAL routine that adds the interrupt bit number of the module to the number 31.60.

If two interrupt modules are used in the first crate, the line numbers 31.31-31.54 and 31.61-31.84 are assigned to them.

A special configuration of the hardware system, as described above, characteristically requires some data (i.e. number of crates, crate addresses, modul addresses, etc.) to be loaded into corresponding memory locations of the computer via the switch register.

Fast interrupt handling which does not wait for the end of the current line could be achieved by additional PAL routines. In this case, FOCAL subroutines cannot be used because of re-entry problems. In addition such interrupts must not be



Field 0 Field 1

Fig. 2 Core Map for FOCADAT and FOCALINT 8 k

turned off by the general 'CAMAC ioff' command but only by individual ioff commands (e.g. by use of an interrupt status register).

The core maps for a FOCAL 8 k version are shown in Fig. 2. Apart from the normal FOCAL programs, only the most important routines are in Field 0, in order to save memory locations in the variable buffer. All other routines are located in field 1 and are accessed by reference routines located in field 0. The basic routines of FOCADAT are routines that enable the program to transfer data from the text buffer into CAMAC and vice versa. The basic routine of FOCALINT is the CAMAC INTERRUPT processor, which enables the program to prepare a special line if an interrupt occurs and to return to the background program after execution.

CONCLUSION

This system has been used to good advantage in different applications such as: automatic testing of CAMAC modules, linearity tests on a ramp generator, disturbance tests on twisted-pair lines, and control systems for triple axis neutron spectrometers[3, 4].

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SUMMARY OF CAMAC COMMANDS

1. FOCADAT

(a) General CAMAC command without datahandling:

*ΔCF, C, N, A, F, (Q).
* specifies the entering of a CAMAC statement.
CF = crate function CF is necessary for the crate controller developed at Seibersdorf because it works without a system controller.[2]
CF = 0 if not otherwise specified.
C = crate address
N = module address
A = subaddress
F = function code
Q = response. Q is typed only if storage of Q is wanted.

(b) Special CAMAC commands:

*Δ1, C clear
*Δ2, C initialize
*Δ3, C inhibit set
*Δ4, C inhibit reset
*Δ5, C, L, R READ LAM (conditioned)
C = crate address
L = number of LAM in question (module address)
R = 1 if LAM in question = 1

(c) CAMAC commands accompanied by data transfer:

*Δ6, C, N, A, F, FB, HW, (LW), (Q) read data
*Δ7, C, N, A, F, FB, HW, (LW), (Q) write data
C, N, A, F, Q as specified under a) and b)
FB = Format byte
HW = CAMAC data word if FB = 1 or 2
HW = more significant 12 bit group of CAMAC dataword if FB = 3
LW = less significant 12 bit group of CAMAC data word if FB = 3

Format byte:

FB	Typed Data	Data in CAMAC Register	Maximum Number
1	1 word decimal	binary	2^{23}-1 = 8388607_{10}
2	1 word decimal	decimal	999999_{10}
3	2 words octal	binary	7777777_8

Any number in a CAMAC statement can be typed as a variable (CF, C, N, A, F, etc.) but has to be specified by a SET or FOR command before execution. All numbers are typed in decimal if not otherwise specified.

2. FOCALINT

*Δ 9, C CAMAC interrupt off
*Δ10, C CAMAC interrupt on
C = crate address

These are two new instructions. They are not needed if the CAMAC interrupts are turned on and off by assembly language (PAL) routines.

SPECIFICATIONS FOR STANDARD CAMAC SUBROUTINES

4

by

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Received 28th September 1972

SUMMARY This report has been prepared under the guidance and sponsorship of the CAMAC Software Working Group of the USAEC NIM Committee. It describes six FORTRAN-compatible subroutines allowing CAMAC operations to be specified in a high-level programming language. The fundamental CAMAC operations and standard modes of block transfers are implemented.

INTRODUCTION

The NIM-CAMAC Software Working Group has agreed that the specification of a standard set of subroutines for performing CAMAC operations would facilitate communication, permitting interchange of programs and saving of design effort in the implementation of CAMAC systems. The subroutines should be applicable to as many languages as possible, but must be compatible with FORTRAN, which is the most widely used high-level language in the U.S. at this time. This report describes six subroutines which the Working Group recommends for standard usage. Other subroutines are under active consideration, but it is felt that the best interests of the CAMAC user community are served by rapid publication of the specifications that have been agreed upon to date.

The approach that has been followed in the following specifications is that a single subroutine, 'CMCBSC', capable of performing a very general CAMAC operation, is specified in terms of its inputs and outputs. Then other, more specialized, subroutines are defined as FORTRAN subroutines that make use of the fundamental subroutine, 'CMCBSC'. It should be especially noted that, although all subroutines except 'CMCBSC' are defined as FORTRAN subroutines, an individual installation will quite likely find it advantageous to implement many of them in assembly language, or perhaps in other special ways, in order to take advantage of local hardware and speed up their execution. In these cases the FORTRAN subroutine will serve only as a definition. However, any installation that can provide a local version of 'CMCBSC' and a FORTRAN compiler will have immediately available a library of CAMAC procedures.

The following general remarks apply to the descriptions of all the subroutines that follow. In specifying subroutine arguments, names of arguments that may be (or must be) arrays end with the letter 'A', and all arguments are integer variables in the FORTRAN sense. All subroutines, function and named-common names (i.e. all global names beginning with the letters 'CMC') are reserved for possible future extensions of the standard subroutines. To the maximum extent practical in the specifications, argument names and meanings are identical from one subroutine to another. Certain arguments (especially crate number, repeat count, data block and error vector) are explained in detail in the description of subroutine 'CMCBSC' and only briefly in the definitions of subsequent subroutines. However, the full definition is intended to apply in every case.

It is necessary for many of the subroutines to have access to the values of certain constants that describe the system, in particular the word length of the computer, the number of modules per crate, and the number of crates per branch. In order that the subroutines can be written in a general way and be reasonably independent of the actual values of these quantities, a named common that contains the values for the system is defined. A sample 'BLOCK DATA' subroutine is given below for a 16-bit computer with normal values for the other quantities.

```
      BLOCK DATA
      COMMON/CMCCOM/NCOMP, NOMOD, NOCRT
C STANDARD NAMED COMMON FOR CAMAC SUBROUTINES.
C NCOMP: NO. OF COMPUTER-LENGTH WORDS NECESSARY TO
C     CONTAIN ONE CAMAC-LENGTH WORD.
C NOMOD: NO. OF MODULES (MAXIMUM) IN A CRATE.
C NOCRT: NO. OF CRATES PER BRANCH,
      DATA NCOMP, NOMOD, NOCRT/2,23,7/
      END
```

I. CMCBSC

Purpose:

to perform a single CAMAC function at a single CAMAC address one or more times.

Calling sequence:

CALL CMCBSC (F, B, C, N, AD, LN, DATA, Q, ERRORA).

Arguments:

F: CAMAC function code.

B: Branch number.

C: Crate number.

The crate number may be positive, negative, or zero. If it is positive and less than or equal to the number of crates per branch, a single crate operation is specified. Crate number = Ø indicates a branch controller function. If the crate number is between -1 and -127, then its absolute value, taken as a binary number, indicates which crates are to participate in a parallel operation. If the nth bit from the right is a '1', then crate n is addressed. (e.g. $C = -3$ addresses crates 1 and 2.) Crate number $= -128$ indicates all on-line crates are addressed in parallel.

N: Station number.

AD: Subaddress.

LN: Repeat-count and word-length specification.

If F specifies a data transfer function (read or write), the absolute value of LN indicates the number of words to transmit; the sign indicates computer-length words if positive and CAMAC-length words if negative. If F specifies a control or test function, LN must be positive, and it indicates the number of times to repeat the operation.

DATA: Data block.

'DATA' must be an array of sufficient length to supply or to receive the data transmitted by the subroutine while executing the CAMAC command. 'DATA' supplies data during write operations and receives data during read operations.

If the computer word length is less than 24 bits and LN is negative for a read or write function, each CAMAC word will be stored in a contiguous block within the array 'DATA', which will be the smallest integral number of words required to hold 24 bits. The word within the block having the greatest address is filled with the lowest order bits of the CAMAC word. Computer words having successively smaller addresses are filled with successively higher order bits of the CAMAC word until the last, which is filled-out with high-order zeros if necessary. Note that although B, C, N, and AD remain constant in this subroutine, the computer storage address is incremented for each transmission.

Q: Q response from the last execution of the function.

ERRORA: Error vector.

Errors detected by the hardware or errors detected in arguments are indicated in this array. If the first word of the error vector is set to Ø, i..e, ERRORA (1) = Ø, no errors were detected. If ERRORA (1) > Ø, then it contains an error code, and the following three words may contain supplementary information about the error. The codes are:

1. Dataway timing error
2. Branch highway timing error (e.g. offline crate)
3. Illegal branch no.
4. Illegal crate no. (e.g. crate no. greater than 7)
5. No X response
6. Illegal function code (e.g. not in the range Ø to 31)
7. Illegal station no. (e.g. not in the range Ø to 31)
8. Illegal subaddress (e.g. not in the range Ø to 15)
9. Illegal value of LN
1Ø. Starting CAMAC address is less than ending CAMAC address (see CMCASC)

ERRORA (2) contains the execution count at the time the error was detected. The subroutine stops execution when an error occurs and does not attempt to complete the requested number of function executions. ERRORA (3) is used as a cumulative error count. Whenever an error is detected, its value is increased by 1.

II. CMCSEQ

Purpose:

To execute a single CAMAC function at a succession of CAMAC addresses.

Calling sequence:

CALL CMCSEQ (F, BA, CA, NA, ADA, LN, DATA, Q, ERRORA)

Arguments:

F: CAMAC function code.
BA: Branch numbers.
CA: Crate numbers.
NA: Station numbers.
ADA: Subaddresses.
LN: Repeat-count and word-length specification. (+ = computer length; − = CAMAC length.)
DATA: Data block.
Q: Q response from last execution of function.
ERRORA: Error vector (integer array of length 4).

FORTRAN definition:

```
      SUBROUTINE CMCSEQ(F, BA, CA, NA, ADA, LN, DATA, Q,
     1 ERRORA)
      COMMON/CMCCOM/NCOMP, NOMOD, NOCRT
      INTEGER F, BA(2), CA(2), NA(2), ADA(2), DATA(2), Q,
     1 ERRORA(4)
C SET NUMBER OF WORDS PER TRANSFER.
      NWDS=NCOMP
      IF(LN.GT.Ø) NWDS=1
C SET NUMBER OF EXECUTIONS.
      K=IABS(LN)
      IF(K.EQ.Ø) GO TO 3Ø
C LOOP THROUGH CALL TO SUBROUTINE CMCBSC.
      DO 1Ø I=1, K
      M=I*NWDS—NWDS+1
      CALL CMCBSC(F, BA(I), CA(I), NA(I), ADA(I), ISIGN(1,LN),
     1 DATA(M), Q, ERRORA)
C CHECK FOR ERROR.
      IF(ERRORA(1).NE.Ø) GO TO 2Ø
   1Ø CONTINUE
      RETURN
   2Ø ERRORA(2)=I
      RETURN
   3Ø ERRORA(1)=9
      ERRORA(2)=Ø
      ERRORA(3)=ERRORA(3)+1
      RETURN
      END
```

Note:

Subroutine 'CMCSEQ' could just as well serve as the fundamental CAMAC subroutine as subroutine 'CMCBSC' since for LN = 1 or LN = −1 they are identical in function, and any other sequence of CAMAC operations can be constructed from them.

III. CMCASC

Purpose:

To execute a specified CAMAC function in the address scan mode.

Calling sequence:

CALL CMCASC (F, BI, CI, NI, AI, BF, CF, NF, AF, LN, DATA, ERRORA, NEX)

Arguments:

F: CAMAC function code.
BI: Initial branch number.
CI: Initial crate number.
NI: Initial station number.
AI: Initial subaddress.
BF: Final branch number.
CF: Final crate number.
NF: Final station number.
AF: Final subaddress.
LN: Execution limit and word size indication. (+ = computer length; − = CAMAC length.)
DATA: Dimensioned array for data sent or received.
ERRORA: Error vector.
NEX: Number of times function was executed with a Q = 1 response. (Number of words transmitted if function is read or write.)

Addressing rule:

The specified function is executed first at the address given by BI, CI, NI, AI. Then if the Q response is 1, the subaddress is incremented by 1 and the index into the data block incremented by either 1 or the number of computer words necessary to contain a CAMAC word, depending on the sign of LN, and the function executed at this new subaddress. If the Q response is Ø, the subaddress is set to zero, the data block index is not changed, and the station number is incremented by 1 for the next execution. When the station number is incremented beyond the value of "NOMOD", it is set back to 1 and the crate number is incremented. If the crate number is incremented beyond the value of "NOCRT", it is set back to 1, and the branch number is incremented. The total number of executions of the function is limited by the magnitude of LN and by the stated final values of the CAMAC address, BF, CF, NF, AF. Special attention must be paid to the X response in the address scan mode. When a module responds with Q = Ø, it may at the same time give X = 1 or X = Ø; consequently in this mode of access the X response is ignored when the Q response is Ø.

FORTRAN definition:

```
      SUBROUTINE CMCASC (F, BI, CI, NI, AI, BF, CF, NF,
         AF, LN, DATA, ERRORA, NEX)
      COMMON/CMCCOM/NCOMP, NOMOD, NOCRT
      INTEGER F, BI, CI, AI, BF, CF, AF, DATA(2), ERRORA(4)
      INTEGER B, C, A, Q
SET MAXIMUM NUMBER OF EXECUTIONS.
      K=IABS(LN)
SET NUMBER OF WORDS PER DATA TRANSMISSION.
      NWDS=NCOMP
      IF(LN.GT.Ø) NWDS=1
CHECK FOR ARGUMENT ERROR.
      IF(K.EQ.Ø) GO TO 5Ø
      IF(BF.GT.BI) GO TO 5
      IF(BF.LT.BI) GO TO 6Ø
      IF(CF.GT.CI) GO TO 5
      IF(CF.LT.CI) GO TO 6Ø
      IF(NF.GT.NI) GO TO 5
      IF(NF.LT.NI) GO TO 6Ø
      IF(AF.LT.NI) GO TO 6Ø
SET INITIAL VALUES OF B, C, N, A.
    5 B=BI
      C=CI
      N=NI
      A=AI
J IS USED TO INDEX THE ARRAY "DATA".
I COUNTS THE NUMBER OF EXECUTIONS OF THE FUNCTION.
      J=1
      I=Ø
HAVE WE EXCEEDED THE MAXIMUM ALLOWABLE NUMBER OF
   EXECUTIONS OF THIS FUNCTION?
   1Ø IF(I.GE.K) GO TO 3Ø
EXECUTE THE FUNCTION ONCE.
      CALL CMCBSC(F, B, C, N, A, ISIGN(1, LN),DATA(J), Q,
         ERRORA)
CHECK FOR ERROR.
      IF(ERRORA(1).NE.Ø) GO TO 28
CHECK Ø.
      IF(Q.EQ.Ø) GO TO 4Ø
INCREMENT THE CORE ADDRESS INDEX AND THE CAMAC
   SUBADDRESS.
      I=I+1
      J=J+NWDS
      A=A+1
      IF(A.GT.15) GO TO 4Ø
CHECK FOR END OF RANGE.
   2Ø IF(B.LT.BF) GO TO 1Ø
      IF(B.GT.BF) GO TO 3Ø
      IF(C.LT.CF) GO TO 1Ø
      IF(C.GT.CF) GO TO 3Ø
      IF(N.LT.NF) GO TO 1Ø
      IF(N.GT.NF) GO TO 3Ø
      IF(A.LE.AF) GO TO 1Ø
      GO TO 3Ø
B, C, N, A, OR I HAS EXCEEDED LIMIT: HALT EXECUTION OF
   CAMAC FUNCTION.
   28 IF((ERRORA(1).EQ.5).AND.(Q.EQ.Ø)) GO TO 38
   3Ø NEX=I
      RETURN
GO TO NEXT MODULE.
   38 ERRORA(1)=Ø
      ERRORA(3)=ERRORA(3)-1
   4Ø A=Ø
      N=N+1
      IF(N.LE.NOMOD) GO TO 2Ø
GO TO NEXT CRATE.
      N=1
      C=C+1
      IF(C.LE.NOCRT) GO TO 2Ø
GO TO NEXT BRANCH.
      C=1
      B=B+1
      GO TO 2Ø
ERRORS DETECTED IN ARGUMENTS.
1. LN=Ø
   5Ø ERRORA(1)=9
      ERRORA(2)=Ø
      ERRORA(3)=ERRORA(3)+1
      RETURN
2. (BI, CI, NI, AI) IS GREATER THAN(BF, CF, NF, AF).
   6Ø ERRORA(1)=1Ø
      RETURN
      END
```

IV. CMCRPT

Purpose:

To execute a specified CAMAC function in the repeat mode.

Calling sequence:

CALL CMCRPT (F, B, C, N, AD, LN, DATA, ERRORA)

Arguments:

F, B, C, N, AD: As in CMCBSC
LN: Execution-limit and word-size indication. (+ = computer length; − = CAMAC length.)
DATA: Dimensioned array for data sent or received.
ERRORA: Error vector.

Execution rule:

In the repeat mode the CAMAC address, (B, C, N, A) is never changed, but the single address is expected to supply many words of data. Q is used as a timing signal; Q = 1 indicates that the previously executed function succeeded; Q = Ø indicates that the module was not ready to accept the function and that the controller should try again.

FORTRAN definition:

```
      SUBROUTINE CMCRPT(F, B, C, N, AD, LN, DATA,
         ERRORA)
      COMMON/CMCCOM/NCOMP, NOMOD, NOCRT
      INTEGER F, B, C, AD, DATA(2), ERRORA(4), Q
SET NO. OF COMPUTER WORDS PER TRANSFER.
      NWDS=NCOMP
      IF(LN.GT.Ø) NWDS=1
SET NUMBER OF EXECUTIONS.
      K=IABS(LN)
CHECK FOR ZERO.
      IF(LN.EQ.Ø) GO TO 4Ø
SET EXECUTION PARAMETER FOR "CALL CMCBSC".
      L=ISIGN(1.LN)
INITIALIZE LOOP.
      J=1
      I=Ø
   1Ø IF(I.GE.K) RETURN
INCREMENT TALLY.
      I=I+1
ATTEMPT TO EXECUTE FUNCTION.
   2Ø CALL CMCBSC(F, B, C, N, AD, L, DATA(J), Q, ERRORA)
      IF(ERRORA(1).NE.Ø) GO TO 3Ø
      IF(Q.EQ.Ø) GO TO 2Ø
INCREMENT STORAGE ADDRESS AND LOOP BACK.
      J=J+NWDS
      GO TO 1Ø
ERROR, STORE EXECUTION COUNT IN ERRORA(2).
   3Ø ERRORA(2)=I
      RETURN
LN=Ø. RETURN ERROR 9.
   4Ø ERRORA(1)=9
      ERRORA(2)=Ø
      ERRORA(3)=ERRORA(3)+1
      RETURN
      END
```

V. CMCSTP

Purpose:

To execute a specified CAMAC function in the stop mode.

Calling sequence:

CALL CMCSTP (F, B, C, N, AD, LN, DATA, ERRORA, NEX)

Arguments:

F, B, C, N, AD: As in CMCBSC
LN: Execution-limit and word-size indication. (+ = computer length; − = CAMAC length.)

DATA: Dimensioned array for data sent or received.
ERRORA: Error vector.
NEX: Number of times function was executed.

Execution rule:

In the stop mode the CAMAC address (B, C, N, A) is never changed, but the single address is expected to supply (or accept) many words of data. It is assumed able to supply or accept a word of data whenever the controller addresses it, until the block is exhausted. The controller may terminate the process if the number of executions exceeds the limit given by the magnitude of LN, or the module may terminate the process by responding with Q = Ø. Q = Ø implies that no data was sent or accepted during the CAMAC cycle for which it is the response. Q = 1 indicates normal execution of the function.

FORTRAN definition:

```
      SUBROUTINE CMCSTP(F, B, C, N, AD, LN, DATA,
     1   ERRORA, NEX)
      COMMON/CMCCOM/NCOMP, NOMOD, NOCRT
      INTEGER F, B, C, AD, DATA(2), ERRORA(4), Q
C SET NO. OF COMPUTER WORDS PER TRANSFER.
      NWDS=NCOMP
      IF(LN.GT.Ø) NWDS=1
C SET NO. OF EXECUTIONS.
      K=IABS(LN)
      IF(K.EQ.Ø)GO TO 3Ø
C SET EXECUTION PARAMETER FOR "CALL CMCBSC".
      L=ISIGN(1,LN)
C INITIALIZE LOOP.
      J=1
      I=Ø
C TEST FOR END OF EXECUTION.
   1Ø IF(I.GE.K) RETURN
C INCREMENT EXECUTION TALLY.
      I=I+1
C ATTEMPT TO EXECUTE FUNCTION.
      CALL CMCBSC(F, B, C, N, AD, L, DATA(J), Q, ERRORA)
      IF(ERRORA(1).NE.Ø) GO TO 2Ø
      IF(Q.EQ.Ø) GO TO 2Ø
      J=J+NWDS
      GO TO 1Ø
C ERROR. SET EXECUTION COUNT IN NEX AND EXIT.
   2Ø NEX=I
      RETURN
C ERROR: LN=Ø.
   3Ø ERRORA(1)=9
      ERRORA(2)=Ø
      ERRORA(3)=ERRORA(3)+1
      GO TO 2Ø
      END
```

VI. CMCLUP

Purpose:

To execute a specified CAMAC function at a hierarchical sequence of addresses with the option of skipping certain portions of the sequence based on the Q response.

Calling sequence:

CALL CMCLUP (F, BA, LB, CA, LC, NA, LKN, ADA, LAD, LN, DATA, Q, QON, ERRORA, NEX)

Arguments:

F: CAMAC function code.
BA: Branch number array.
LB: Number of branch numbers.
CA: Crate number array.
LC: Number of crate numbers.
NA: Module number array.
LKN: Number of module numbers.
ADA: Subaddress array.
LAD: Number of subaddresses.
LN: Execution limit and word size indication. (+ = computer length; − = CAMAC length.)
DATA: Data array.
Q: Q response of last execution.
QON: Control argument indicating whether or not to use Q response for skipping addresses. 1 means use Q; Ø means ignore Q.
ERRORA: Error vector.
NEX: Number of times the function was executed, or the number of times the function was executed with a Q = 1 response if QON = 1. (Number of words transmitted for read or write functions.)

Execution rule:

"BA", "CA", "NA", and "ADA" are each one-dimensional arrays containing lists of branch, crate, module, and subaddress numbers respectively. The program executes, or attempts to execute, the function at each CAMAC address which can be formed by combining the elements of these arrays. It begins by choosing the first element of each array and advances the address by choosing the next element of the subaddress array, etc., scanning the subaddresses most frequently, the module numbers next, etc., until the last element of each array is used. If QON = 1, a Q = Ø response will cause the module index to advance and the subaddress index to be set to 1.

FORTRAN definition:

```
      SUBROUTINE CMCLUP(F, BA, LB, CA, LC, NA, LKN,
     1   ADA, LAD  LN, DATA, Q, QON, ERRORA, NEX)
      COMMON/CMCCOM/NCOMP, NOMOD, NOCRT
      INTEGER F, BA(LB), CA(LC), NA(LKN), ADA(LAD),
     1   DATA(2), Q, QON, ERRORA(4)
C SET NUMBER OF COMPUTER WORDS PER TRANSFER.
      NWDS=NCOMP
      IF(LN.GT.Ø) NWDS=1
C SET EXECUTION LIMIT.
      K=IABS(LN)
C CHECK LIMIT FOR ZERO.
      IF(K.EQ.Ø) GO TO 6Ø
C SET EXECUTION PARAMETER FOR "CALL CMCBSC".
      L=ISIGN(1,LN)
C INITIALIZE INDEXES FOR EXECUTION COUNT AND DATA
C    TRANSFER. I COUNTS EXECUTION OF F; J INDEXES "DATA".
      I=Ø
      J=1
C SET UP FOUR NESTED DO'S TO EXECUTE THE ADDRESSING
C    ALGORITHM.
      DO 4Ø MB=1, LB
      DO 4Ø MC=1, LC
      DO 4Ø MN=1, LKN
      DO 3Ø MAD=1, LAD
C ATTEMPT TO EXECUTE FUNCTION ONE TIME.
      CALL CMCBSC(F, BA(MB), CA(MC), NA(MN),
     1   ADA(MAD), L, DATA(J), Q, ERRORA)
C IS Q BEING CHECKED?
      IF(QON.EQ.Ø) GO TO 2Ø
C YES. JF Q=1, PROCEED NORMALLY. IF Q=Ø, IGNORE X
C    RESPONSE AND BRANCH TO END OF N LOOP.
      IF(Q.EQ.1) GO TO 2Ø
      IF((ERRORA(1).EQ.5).OR.(ERRORA(1).EQ.Ø)) GO TO 4Ø
      GO TO 7Ø
C INCREMENT DATA INDEX AND EXECUTION COUNT,
C    TEST EXECUTION LIMIT.
   2Ø I=I+1
      J=J+NWDS
      IF(I.GE.K) GO TO 5Ø
C DO NORMAL ERROR CHECK.
      IF(ERRORA(1).NE.Ø) GO TO 7Ø
C END OF SUBADDRESS LOOP.
   3Ø CONTINUE
C END OF BRANCH, CRATE, MODULE LOOPS.
   4Ø CONTINUE
C SET EXECUTION COUNT AND RETURN.
   5Ø NEX=I
      RETURN
C LN=Ø, GIVE TYPE 9 ERROR.
   6Ø ERRORA(1)=9
      ERRORA(2)=Ø
      ERRORA(3)=ERRORA(3)+1
      RETURN
C ERROR. SET ERRORA(2) TO EXECUTION COUNT
   7Ø ERRORA(2)=I
      GO TO 5Ø
      END
```

IDEAS AND TECHNIQUES

1

THE HOLD AND PAUSE MODES FOR CAMAC BLOCK-TRANSFERS

by

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Received 7th September 1972

SUMMARY The Pause mode of block transfer to or from a CAMAC module can be used when there is uncertainty about both the block length and the readiness of the module. Alternatively, the standard Stop mode, which deals with block length, can be augmented by the Hold technique.

INTRODUCTION

A block transfer is a controller-organised automatic transfer of a number of data words from module(s) to the controller (for Read) or from the controller to module(s) (for Write). It is conceivable, but rare, to have dataless block transfers or 'block commands'.

When considering block transfers to or from the same module-address, two specific modes ('Repeat' and 'Stop' modes) have been described in the ESONE document EUR 4100e (1972) as examples of the use of the module response Q. In the 'Repeat' mode the total number of words must be known. In the 'Stop' mode the data must always be ready (Read) or accepted (Write).

The purpose of this note is to describe a more general block transfer, as used in CERN where the following conditions can both exist:

— Data may not be ready (Read) or cannot be accepted (Write).

— The total number of words is not known by the controller.

These two conditions are typical in nuclear physics applications but the solution of the problem may be of general interest.

PROPOSALS

Two solutions are possible:

— 'Hold' mode, which can also be used in applications that do not involve block transfers. This mode was described previously in CERN-NP CAMAC Note 38-00 on Timing and also in *CAMAC Bulletin* No. 3, March, 1972 p. 8. A very short résumé is given below.

— 'Pause' mode. A more classical solution of the problem, using only the existing rules. This mode has the same maximum rate as the Repeat or the Stop modes, but repeated search times may slow down transfers. We shall particularly describe the Pause mode in this note.

"HOLD" MODE

This mode can also be used for any single command. It offers the possibility for an addressed location to stop (Hold) the CAMAC cycle in the Crate Controller for as long as is required. In this respect it can be regarded as extending the variable timing of the branch highway BTA/BTB conversation back to the module. The 'Hold' action is obtained by the module pulling down P2 (one of the new 'free bus lines' as allocated by ESONE, see EUR 4100, 1972). The CAMAC cycle is then stopped (before Sl) by the Crate Controller until P2 is released to the high state by the module.

Applied to block transfers, this feature allows the transfer to be delayed for as long as necessary. The module response Q is therefore free from timing considerations and is only used to indicate 'End of Block' by $Q = 0$.

The Hold feature, though not specifically endorsed by ESONE, is a legitimate use of P2. It provides a very flexible and automatic cycle adjustment and has been included as a patchable option in most commercial Type A Crate controllers.

"PAUSE" MODE

Principle

The flow diagram, Fig. 1, shows the principle used. It is based on the following use of Q, combined with the generation of a LAM ($= L_{end}$) when the transfer must be ended:

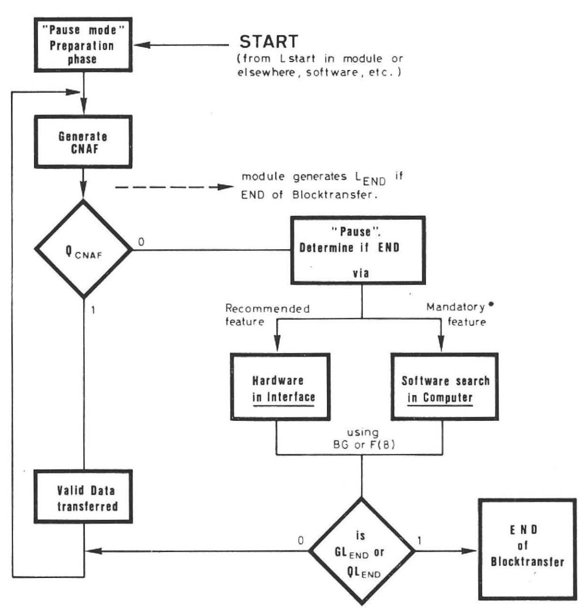


Fig. 1 Pause Mode Flow Diagram

* Mandatory feature should not be used if the recommended feature is operative.

— Module response $Q = 1$ means 'OK, go on (Data is presented or accepted *and* the block transfer is not finished)'.

— Module response $Q = 0$ means 'Test whether the condition is Not Ready *or* End of Block'.

This test can be organised by hardware or software in the controller. It involves testing a LAM request (L_{end}) with the following significance:

$L_{end} = 0$ means continue the block transfer but wait first for $Q = 1$.
or $L_{end} = 1$ means End of Block.

As seen from the module the rules for Pause mode are:

$\text{Data} \cdot \overline{\text{End}} \rightarrow Q = 1$
$\overline{\text{Data}} + \text{End} \rightarrow Q = 0$
$\text{End of Block} \rightarrow L_{end} = 1.$

As seen from the interface or computer the rules are:

$Q = 1 \rightarrow$ Repeat command

$Q = 0 \rightarrow$ Test L_{end}:

if $L_{end} = 0$ Repeat Command
{ If $Q = 1$ continue
{ If $Q = 0$ repeat test
if $L_{end} = 1$ End of block

CAMAC Compatibility

To be general purpose and allow module/interface interchangeability, L_{end} must have the possibility of being tested and used under software control.

A special hardware feature in the computer interface is recommended, for speed, to test L_{end} automatically by F(8) when $Q = 0$ in 'Pause' mode. If $L_{end} = 1$ the computer interface should terminate the sequence of transfers. If this special hardware feature is foreseen in an interface, L_{end} should not access the computer, but should be disconnected or masked, etc.

CONCLUSION

The 'Pause' mode offers a simple standard way of doing block transfers in which data may not be 'ready' and the total number of words is unknown. The 'Hold' mode is of general interest for influencing the CAMAC cycle (for all commands) and is therefore also directly applicable to block transfers.

2

UNIVERSALLY APPLICABLE CAMAC MODULES

by
Dietrich Reimer and Ingo Liebig
Dornier A.G., Friedrichshafen, Germany
Received 30th October 1972

SUMMARY Differing specifications for external connections often lead to families of CAMAC modules, with many common features and some specific features such as external signal standards. The development of such families of modules can be rationalised by using submodular construction and internal patching, as described in this paper.

During the ESONE General Annual Assembly in Jülich it was announced for the first time officially that it is intended to use CAMAC process peripherals in other than nuclear instrumentation systems. This presents a new problem to CAMAC standardisation. CAMAC modules then must meet very different specifications concerning the connection to the 'outside world'.

Digital inputs and outputs as well as analog inputs and outputs need to be capable of fulfilling varied conditions. In order to offer suitable modules for all of the levels, signals and data rates, an enormous development effort would be required, and this in spite of the fact that the circuitry of many modules is identical. A solution to these problems can be found in the following ways.

Sub-modular construction. The identical parts, such as the logic elements of different digital output modules, are assembled on the first half of a CAMAC board as a self-contained functional unit. The input or, as depicted in the example (Fig. 1), the output signals are brought out to a connector. The signal connections to the process or the special output

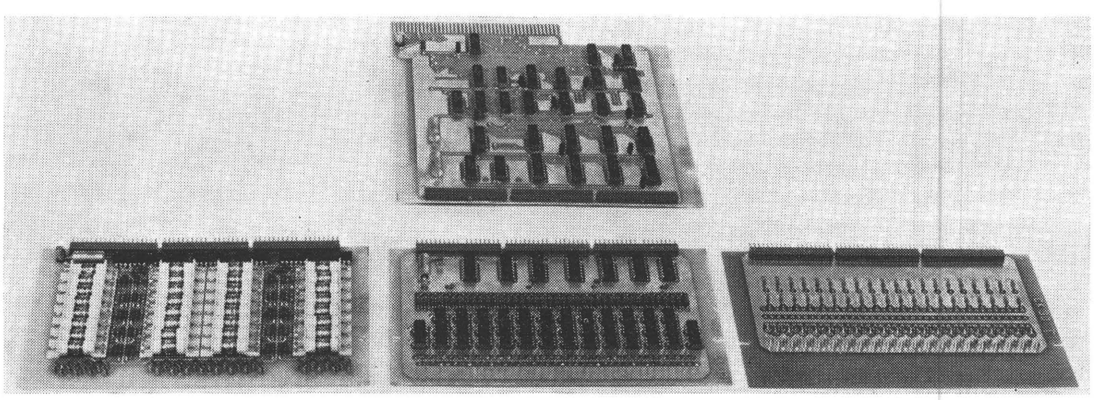


Fig. 1 Sub-modular Construction of a Digital Output Module with Three 'Front-end' Options

circuits are then assembled on the second half of another CAMAC board which is plugged onto the basic board. In principle, the two board parts could be connected by wire links. This is, however, not advisable on account of the difficulties involved in modifying such a module, and on account of the low additional costs of inter-board connectors, typically only one thousandth of the price of a module.

The following modules are manufactured by Dornier in this way:

— Digital Inputs 40-bit with:
  - TTL connection,
  - high-level logic adaption,
  - optocouplers,
  - external strobe;

— Digital Outputs 32-bit with:
  - TTL connection,
  - open collector,
  - reed relay,
  - programmable amplifier/attenuator;

— Analog Inputs (DAC):
  - 8-bit, 12-bit,
  - direct connection (1 input),
  - 8 input channels, differential,
  - 8 input channels, single ended;

— Multiplexers:
  - electronic, 8 channels differential,
  - electronic, 16 channels differential,
  - electronic, 32 channels differential,
  - electronic, 16 channels single ended,
  - electronic, 32 channels single ended,
  - relay, 16 channels, 2 contacts,
  - relay, 32 channels, 2 contacts.

Internal Patching. Another possibility exists for achieving universal applicability of analog modules, for example by different voltage levels. All elements for the different circuits are provided on the basic board. The individual elements are then energised by links or resistors soldered into simple IC sockets. These sockets, in turn, are inserted into a second IC socket which is part of the printed basic board. Fig. 2 shows an example of AD converter programming by this method.

Plug-in Sub-assemblies. If different combinations of several functional units are to be used in a larger basic circuit, or if complex functions are to be realised which cannot be programmed according to the method described above, it might be suitable to assemble these functional units on separate small printed circuit boards. Several such miniature boards could then be plugged into a basic circuit. In this way it is possible to increase the element density per module, provided the elements are small enough.

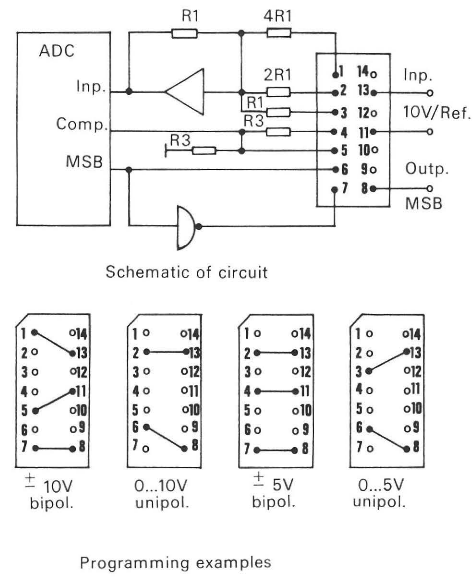


Fig. 2 Programming an Analog-to-Digital Converter

The advantages to the manufacturer are as follows:

— Board design costs are reduced according to dimensions of printed circuit.
— Specific input and output circuits can be developed within a short time.
— In view of the fact that the current production quantities of a particular module type are still relatively small, a better rationalisation effect can be obtained as the quantities of parts of the printed circuits become higher on account of their multiple use.

The advantages to the user are:

— The same basic module is used several times in an automation system. This results in a simplification of servicing.
— The adaption of an automation system to new processes requires minimum investment.
— The programme preparation costs are reduced, as only a few drivers must be programmed.

3

CONSIDERATIONS IN THE DESIGN OF CAMAC-ORIENTED PROCESSORS

by

Charles E. Cohn

Argonne National Laboratory, Argonne, Illinois, U.S.A.

Received 29th May 1972, revised 6th November

SUMMARY This paper considers some design features for a CAMAC-oriented processor. This could yield significant hardware and software economies compared with superimposing a CAMAC system on a processor that is not especially well adapted to it.

INTRODUCTION

The CAMAC system has shown itself to be an extremely powerful approach to the implementation of computer-oriented instrumentation systems. However, its full potential can only be realized with a processor specifically designed to operate with it. This could yield significant hardware and software economies over the present approach in which a CAMAC system is superimposed upon a processor not especially well adapted to it. It is the purpose of this paper to consider some design features for a CAMAC-oriented processor, based on the author's experience in implementing CAMAC systems on conventional computers.[1]

WORD LENGTH

To begin with, the word length of a CAMAC-oriented processor should be no less than 24 bits, for a variety of reasons. First, the correspondence with the width of the CAMAC dataway would eliminate the awkward two-step read and write operations needed with short-word machines. Second, a 24-bit instruction word would allow significant improvements in the implementation of programmed dataway operations, as will be explained later. Third, it has been argued elsewhere[2] that the 24-bit word length is more cost-effective than shorter word lengths, due to the greater efficiency of all processor operations.

PROGRAMMED TRANSFERS

A significant inefficiency in present CAMAC systems is the awkward manner in which programmed data transfers must be done. These operations require a device-command instruction to transmit CNAF followed by an input or output instruction to perform the actual read or write. This pair must be preceded by an interrupt-inhibit instruction and followed by an interrupt re-enable. Otherwise, an interrupt occurring just after the device-command could initiate another CAMAC operation and thus perturb CNAF before the input or output instruction is executed. In addition, some computers require separate status-test instructions to examine the Q response.

Conventional processors, then, require four or more instructions to perform a task that should really require only one. To avoid this inefficiency, the CAMAC-oriented processor would have two input-output instructions, i.e., CAMAC Input-to-Accumulator and CAMAC Output-from-Accumulator. (The latter would also execute control commands, where the state of the W lines is irrelevant.) These instructions would carry CNAF within the instruction word. After execution, the next instruction would be skipped or not, depending on the Q response. The X response, whose absence indicates a malfunction, would initiate an interrupt to a special trap location in that event. Since all peripherals would be interfaced via CAMAC, no other input-output instructions would be needed.

With 14 bits required to specify NAF and six bits for the instruction code, a 24-bit instruction word would still leave plenty of room to specify C. (In 12- or 16-bit machines, these would have to be two-word instructions, requiring an additional memory cycle. Also, interrupt inhibit and enable instructions would still be needed for two-step read or write operations, so much of the improvement from this scheme would be vitiated.)

Upon execution, these instructions would place NAF on the dataway and would initiate the dataway cycle. The various events in the cycle would be timed by the computer clock. The skip-or-not decision would be taken at S1 time, and the dataway cycle would complete while the next instruction was being fetched and executed.

In the CAMAC-oriented processor, multicrate operation would be extremely convenient, with no need for branch-highway organization. The R, W, A and F lines of corresponding number from different crates, as well as the Q, S1, S2, B and Z lines from the various crates, would be strapped together. C would then merely determine which crate was to receive the selected N.

LAM handling would also be extremely convenient. With the graded-L circuits incorporated directly within the processor, the priority encoders would generate a memory address directly, Thus, each priority level would have its own unique interrupt location, and a separate operation to read the graded L would not be needed.

FAST TRANSFERS

These provisions would improve the efficiency of programmed data transfers to the point where that mode of operation would be adequate for all but the very highest data rates. Thus, most applications* could get along without the various direct-memory-access schemes that have been proposed, which are about as complex and costly as the processor itself. The author feels that those resources are better spent in upgrading the processor. The author also believes that the intermingling of commands and data makes CAMAC ill-adapted for extremely fast data transfer, and that such applications are best handled by specially-designed interfaces connected to direct-memory-access channels or memory ports.

REFERENCES

1. C.E. Cohn and S.J. Rudnick, 'CAMAC Crate Controllers for the Systems SEL-840 and Honeywell DDP-24 Computers,' ANL-7886 (1972).
2. C. E. Cohn, 'Speed Tests, Costs and Word Length,' *Datamation*, 17 (20), 26-29 (1971).

* Especially applications outside of nuclear physics, which would become increasingly important if CAMAC becomes the system of choice for computerized instrumentation, as some have predicted.

ACTIVITIES OF THE CAMAC WORKING GROUPS

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

ESONE-CAMAC WORKING GROUPS

Dataway Working Group

Chairman: H. Klessmann, HMI Berlin

At its meeting in September, 1972 the ESONE Dataway Working Group reached final agreement with the NIM Committee on the text of the Supplementary Information document that provides a means for publishing supplementary information on CAMAC practices and interpretations which have been reviewed by the Working Groups, but does not contain mandatory specifications. The document was presented to the ESONE General Assembly in October 1972 and then adopted by the Executive Group. It is published in the US by the AEC-NIM Committee as AEC report TID 25877 (December 1972) and in Europe by the ESONE Committee as supplement to *CAMAC Bulletin* No. 6.

At the November 1972 meeting the major activity of the Working Group was, and will continue to be, concentrated on the Serial Branch Transmission which allows bit- or byte-serial data transfer in multicrate systems and has found great interest for applications where long distance transmission between CAMAC Crates or simple interconnections are required. Proposals on this subject are being exchanged between the ESONE and NIM Dataway Groups and it is expected that good communication and excellent cooperation will result in a common proposal for the specification of a Serial Branch Highway. It is intended to present a first draft on the serial Highway to the ESONE General Assembly in June 1973.

The Working Group also discussed problems of the interpretation of the EUR 4600 e (1972) specifications on the Command Accepted (BX)-signal and the Dataway Inhibit (I) signal of Crate Controller CCA-1. The recommendations given by the WG are published in this issue (see p. 7).

Furthermore a proposal on a distributed multiplexing scheme for implementation of systems with more than one branch and/or more than one computer has been prepared which includes many ideas from earlier discussion by the DWG but with new features of independence from geographical priority, and the ability to communicate between sources. The discussion and decisions on this topic are however constrained due to the high priority of the work on the Serial Branch Highway.

Software Working Group

Chairman: I.N. Hooton, AERE Harwell

The current state of the CAMAC and Intermediate Languages was presented to the General Assembly at Jülich.

The Assembly made it clear that they require the Intermediate Language as a low-level-programming language in addition to its function as an object or listing output of a CAMAC translator. This requirement has been confirmed by the NIM-CAMAC and ESONE Software Working Groups. The language is to be fully explicit in its definition of the CAMAC operations to be performed, but independent of the means of implementation. For example it should not reflect the mechanism of a particular hardware interface between a computer and CAMAC.

Such a language is well advanced and it is intended to release a proposal at the General Assembly in June. The detailed examination of the users' requirements has also helped considerably in the critical review of the "Proposal for a CAMAC Language".

The working group continues to collaborate closely with the American Working Group and with the Dataway Working Group.

Particular topics under review are the serial connection of CAMAC crates and the assignment of pseudo-CAMAC addresses to features of the system controller hardware.

Analogue Signals Working Group

Chairman: T. Friese, HMI Berlin

The proposed specifications for fast (1NB)* and slow (5PB)* signals, to be presented in a combined document, were discussed during the AWG Session in Jülich on October, 1972.

Changes to the draft papers during this discussion were insignificant and the ESONE General Assembly, in consequence, authorized the ESONE Executive Group to publish a definite draft.

The frequency range for fast signals was reconsidered by ESONE WG Members. The NIM-CAMAC AWG also exchanged ideas on appropriate specifications with ESONE AWG which will establish in the near future whether the proposed changes will contain all ideas and wishes.

An early agreement between the NIM and ESONE AWGs is expected.

* 5P stands for + 5V and 1N for − 1V.
'B' says that the output impedance of units is 50 ohms.

Information Working Group

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

The Working Group has recognised that work on CAMAC-oriented software has increased remarkably by introducing a new section in the *Bulletin* devoted to software papers. During 1973 several papers are expected for publication and will demonstrate the growing number of non-nuclear CAMAC applications.

Two new members of the Working Group were welcomed during its November meeting, Mr. P. Christensen from Risö, Denmark and Mr. A. Starzynski from Swierk, Poland. Their valued efforts will considerably reinforce the activities of the Working Group and improve the representation of the different geographic regions of Europe within the Working Group and thereby in the content of the *Bulletin*.

NIM-CAMAC WORKING GROUPS

General

Louis Costrell, Chairman, NIM Committee

The NIM-CAMAC Working Groups met in conjunction with the Nuclear Science Symposium in Miami Beach, Florida in December 1972. Brief reports from the WG chairmen are given below. Working Group Meetings scheduled for 1973 are as follows:

Dataway WG Software WG	April 3-6, 1973 at National Accelerator Laboratory, Batavia, Illinois
Dataway WG, Software WG, Analogue Signals WG	July 9-13, 1973 at TRIUMF University of British Columbia Vancouver, B.C. CANADA
Mechanics and Power Supplies WG	November 9-16, 1973 San Francisco, California (in conjunction with 1973 Nuclear Science Symposium)

Dataway Working Group

Chairman: F. Kirsten, Lawrence Berkeley Laboratory

The NIM-CAMAC Dataway Working Group met in Boulder, Colorado, July 10 and 11, 1972 and more recently at Miami Beach, December 1 and 2.

Discussion at the Boulder meeting was mainly concerned with the final details of the Supplementary Information draft. Subsequently, this document was given joint approval by the NIM and ESONE committees. In addition, discussions on the subject of a Serial Highway for interconnecting a system of CAMAC crates were continued.

Between the Boulder and Miami meetings, the Serial Highway sub-committee, with Don Machen of the Los Alamos Scientific Laboratory as Chairman, met twice. At Miami, they presented a draft of a proposal for a Serial Highway specification. Discussion of this proposal was the main item of business at the Miami meeting. News on the current ESONE discussions on the same topic was brought by Dr. K.D. Müller of KFA, Jülich. The sub-committee was directed to prepare a revised and expanded draft, which will include the conclusions of the Miami meeting as well as further work by the sub-committee. This draft is to be completed in time to transmit to the ESONE Dataway Working Group meeting in Paris in February.

Software Working Group

Chairman: S. Dhawan, Yale University

The Software Working Group is finishing work on a standard set of CAMAC Subroutines for use with FORTRAN. It is hoped that these subroutines will be found useful with a variety of procedural languages and assembly languages as well. This set of subroutines are presented in this Bulletin issue (see p. 23) and will be published also in the April 1973 CAMAC Tutorial Issue of the IEEE Transactions on Nuclear Science.

Collaboration has been started with the Purdue workshop on the standarization of industrial Computer languages. This workshop is publishing its Standard Software through the Instrument Society of America.

Mechanical & Power Supply Working Group

Chairman: D.A. Mack, Lawrence Berkeley Laboratory

Preferred auxiliary and power supply connectors have now been designated in the Supplementary Information on CAMAC Systems (TID-25877). Fifty-two, 88 and 132 -pin auxiliary connectors facilitate communication to and from plug-in units. There is interest in designating an additional auxiliary connector with less than 52 pins, especially for use in connection with the Serial Highway.

The preferred 50-pin power connector is useful for mating supplies to the Dataway power lines.

A unit has been developed for determining the existence of short or open circuits among the 2150 contacts on the Dataway. Further information is available from the Lawrence Berkeley Laboratory.

Analog Signals Working Group

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

The ESONE and NIM-CAMAC Analog Signals Working Groups have collaborated in the development of analog signal standards for fast signals. Accordingly, the ESONE AWG presented a draft revision of EUR 5100, "CAMAC Specification of Amplitude Analog Signals," to the ESONE General Assembly at Jülich, Germany in October 1972. The draft revision was considered further by the NIM-CAMAC AWG at Miami Beach, Florida in December 1972, with K.D. Müller participating on behalf of ESONE. Further clarification and minor modifications were arrived at and were transmitted to ESONE.

The proposed specifications include two classes of recommended signals, class 1NB (−1 volt) with a terminated 50 Ω input and class 5PB (+5 volts) with 50 Ω output and a matched or unmatched termination. For signals with rise times less than 30 ns class 1NB is recommended. For signals with rise times greater than 30 ns both 1NB and 5PB are recommended classes.

NEW PRODUCTS

SYSTEM UNITS, TEST EQUIPMENT

Crate Controller (CC-A1)

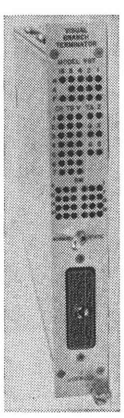
The Techcal Electronics CC-Al Crate Controller is designed to meet the specifications in EURATOM Report EUR 4600e (March 1972). The new specifications allow the CC-A1 to be used in the most advanced CAMAC systems, while preserving its compatibility with older CAMAC systems which require only the type A.

In addition to complying with the new Type A-1 specifications, the controller has the following additional features:

— Branch Command signals are stored in registers.
— Controller cannot be switched 'on line' if another controller on the Branch Highway is using the same Crate Address.
— X and BX (Command accepted) lines are properly utilized.
— Dataway P2 line used as command sequence 'Hold' allowing 'handshake' delay of dataway timing.
— Optional grounding of Bx9-Bx9 lines.
— Branch Highway skew compensation.
— Branch Highway receivers and drivers are better than specified in EUR 4600e.
— CERN-approved dataway pull-up specification.

Ref. Techcal Electronics

Visual Branch Terminator



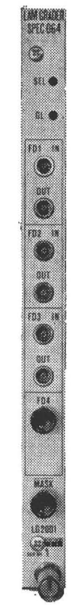
The Joerger Enterprises Visual Branch Terminator (model VBT) conforms to EUR 4100e (TID-25875) and EUR 4600e (TID-25876), 1972. It provides visual indication of the condition of the branch signals on 65 LED lights, in addition to terminating the Branch Highway, and is an invaluable tool when trouble-shooting a branch system or as a visual indicator during system operation. It provides two modes of operation, 'Static' and 'Normal'. The 'Static' mode allows the monitoring of the signals on a D.C. basis. In 'Normal' mode the data is strobed into memory so that the operation just performed can be checked. This eliminates the problem of looking at signals with a scope and synchronizing them in time to find out what the signal levels were when the data was accepted. The data is strobed into memory when the last active BTB signal responds that it is ready. At the same time the Branch Driver will take the data and so the signals displayed are the same as those the Branch Driver has accepted.

All 65 signal lines are terminated in 100 ohms to +4.1 volts. This voltage is generated internally by a regulator from the +6 volt supply. By using a regulator and a single resistor, instead of two resistors from +6 volts to ground, as an equivalent of 100 ohms to +4.1 volts the quiescent current is greatly reduced. With all signals at logic '0' the current drain for the terminator board is approximately 25 mA rather than over 750 mA for the resistor-divider type terminators.

Module width: 2 units.
First delivery: 7/72.

Ref. Joerger Enterprises

LAM Grader



This single-width CAMAC module (model, LG 2001) is designed for use with the ACC 2034 'A' Crate Controller. It is located in station 23, next to the crate controller, and the two are connected by a cable between their rear panels with 52-way Cannon connectors. A 22-bit L-request pattern entering the crate controller is transmitted to the LAM Grader by this cable.

The LAM Grader has four internal L-sources. Three are set by front panel inputs (FD1-FD3) and have monitor outputs, the fourth is set by a push-button (FD4). These four and the 22 L-requests from the crate controller are graded on a plug-in matrix board. This produces a 24-bit graded-L pattern which is controlled by a 24-bit mask register before being returned to the crate controller by the rear cable. The mask register may be reset by a push-button, enabling all graded-L outputs. The state of the module is displayed by two indicators. One shows that the module is in a branch or dataway operation, the other shows that a non-zero pattern exists at the graded-L outputs.

The required grading of L-requests is achieved by wiring the plug-in matrix board. As this board can be completely removed, any number of different gradings can be used in the same module by replacing the matrix board.

The unit conforms to CERN 064 specification. With a non-standard command (N(23).A(0).F(6)) the module identification code can be read.

Ref. SEN Electronique

Manual Branch Driver

The Joerger Enterprises Manual Branch Driver Model MBD complies fully with EUR 4100e (TID-25875) and EUR 4600e (TID-25876). It provides a simple means of checking a Type A system. Thumbwheels are provided to address a crate (BCR), a station number (BN), and a subaddress (BA). Toggle switches are provided to write information onto the 24 BRW lines. The unit has two modes of operation, 'Normal' or 'Static', switch selectable. In the 'Normal' mode the unit can perform either a one-cycle or two-cycle operation. Two sets of thumbwheels are provided to select the functions (BF) to be performed during each cycle. The operation is then triggered by generation of a BTA signal either manually or electrically. The command information including the first function to be performed will be gated onto the Highway during the time BTA+BTB. If a two-cycle operation is selected to be performed, a second BTA signal is generated. This time the function used is that on the second set of thumbwheels. This second cycle is performed approximately 10µsec. after the first but this is internally adjustable to a minimum of approximately 2µsec. In the 'Static' mode, instead of the command information being gated onto the Branch only during a cycle, the information is present on the Highway continuously.

An Initialize (BZ) command and a Graded L (BG) cycle can also be performed, triggered either manually or electrically. During a Graded-L all crates are addressed. A signal generator is also provided as a source of CAMAC-compatible signals.

The unit also provides a termination for the Branch Highway of 100 ohms to +4.1 volts. The Manual Branch Driver has been designed to be used in conjunction with the Visual Branch Terminator, which provides a visual indication of the state of the highway in addition to a second termination. This will allow systems to be checked driving the maximum branch load.

Module width: 5 units.
First delivery: 9/72.

Ref. Joerger Enterprises

Dataway Display

A single-width Dataway Display unit (Type C 76451-A16-A1) is available for introductory checks, maintenance and tests of CAMAC equipment and uses a visual display (LED) of all Dataway signals. Tests of data and commands can be performed. If the unit is not addressed all signals on the Dataway are accepted at S1 and the 24-bit data word is stored in a register for display for write: $(\overline{F(8)}.F(16))$ and read operations: $(\overline{F(8).F(16)})$.

A 5V bias supply (0.3A) for test purposes and a switch to clear all registers or to generate a LAM, respectively, are available on the front panel.

Commands:	A(0)	F(0)	Read data
	A(0)	F(1)	Read command
	A(0)	F(8)	Test LAM
	A(0)	F(9)	Clear all registers
	A(0)	F(10)	Clear LAM

Ref. Siemens AG

CAMAC Dataway Display

The Joerger Enterprises Dataway Display Model DD complies fully with EUR 4100e (TID-25875), 1972. It provides a visual display of the Dataway and thus becomes a valuable tool for both troubleshooting and as an indicator during actual operation. It is unique in that it has two modes of operation 'Static' and 'Normal'. In the 'Static' mode the unit displays the *d.c.* signals on the dataway. This mode is especially useful for troubleshooting. Such things as bad or shorted bits become more obvious, where they may have been overlooked in the 'Normal' mode. It also allows the monitoring of a module such as a counting scaler on a continuous basis not on a sample basis as the 'Normal' mode operates. In the 'Normal' mode the data is stored, so that the Dataway-cycle may be analyzed. In this mode the condition of the Dataway signals are strobed into memory at S1 except Initialize (Z) and Clear (C) which are stored at time S2. This information is displayed on front-panel LED indicators. Twenty four lights are provided to display the Read or Write lines. A Read-Write indicator is provided to identify the operation.

Because of the recent bussing of Patch Pins P1 and P2 we have also added indicators for these lines. In as much as these lines may be used in various ways we have added the flexibility of having these lines strobed at either S1 or S2 whichever is more appropriate in a particular application. It is also possible to have these signals stretched like S1, S2, or Busy if this type indication is more suitable.

Due to the large number of powered crates available without any indicators, lights have been added to monitor the ±6 volt and ±24 volt power-lines.

An optional feature is available for crates without *a.c.* On Off power switches. An *a.c.* power switch is provided on the front panel and a male and female *a.c.* line-cord is available at the rear, one end for the *a.c.* line, the other to plug into the crate. Because of the inconvenience of removing the power on these crates many modules are being damaged when inserted into a powered crate. This option should help avoid this problem.

Module width: 1 unit.
First delivery: 10/72.

Ref. Joerger Enterprises

I/O REGISTERS, DISPLAYS

Timer

The Timer (model C 76451-A12-A1) was designed to a specification of KFK Karlsruhe. In association with the manufacturer's presettable 50MHZ and 300MHZ counters, the unit (single-width) forms an integral part of a scaler-timer system applicable for preset-count, preset-measuring and/or pause-time operations.

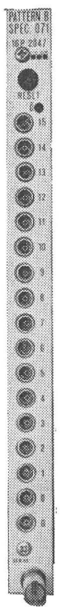
Time intervals between 1µsec and 10×2^{24}µsec can be set via the Dataway with an accuracy of 1µsec. The unit is equipped with a crystal-controlled clock, a 24-bit counting register, a 16-bit status register and a control register to set the operation mode. Patch pin P1 is used to transfer counter overflows.

Commands:

Counting register: A(0)·F(0), A(0)·F(2), A(0)·F(9), A(0)·F(16), A(0)·F(24), A(0)·F(26).
LAM source: A(0)·F(8), A(0)·F(10).
Status Register (Read Register+Clear LAM): A(15)·F(1).
Control Register: A(14)·F(17), A(14)·F(19).
Timer (off, on): A(14)·F(24), A(14)·F(26).

Ref. Siemens AG

16-Input Pattern Unit



A 'Pattern Unit' is a strobed input register for fast signals. The name originates in particle physics, where the unit is used to record event patterns, as detected by radiation counters and processed by fast decision electronics. The module conforms to the CERN 071 specification.

This single-width CAMAC module (model, 16P 2047) is a most compact pattern unit for 16 inputs. A single gate-input controls all data inputs. A non-zero state in the pattern register is displayed by an indicator on the front panel. The pattern register may be reset by a push-button on the front panel.

The module has two sources of L-request. One will be set when a non-zero state is detected in the pattern register. The other will be set on receipt of a pulse at the gate-input. The L-source is selected by a three-position switch on the rear panel. The third position of this switch disables L-request from both sources.

With a non-standard command (A(0)·F(6)) the module identification code of the unit can be read.

Ref. SEN Electronique

Parallel Input Register, 2×16-bit

A 2×16-bit parallel input register (C 76451-A8-A1/2) is available for two classes of input signals:

— single-ended, TTL, negative logic: with a high level of +2.4 to +5.5 V and a low level of 0 to ±0.8 V and an input resistance of 100 Ω (C 76451-A8-A1);

— symmetrical, potential free high-level positive logic with a high level of +11 to +30 V and a low level of −28 to +5 V and an input resistance of 1800 Ω (C 76451-A8-A2).

Two 37-pin connectors are on the front of the single-width unit. Data are taken by read commands or by an external signal (33rd bit).

Commands:

A(0) F(0) Store and read bit 1-16.
A(1) F(0) Store and read bit 17-32.

Ref. Siemens AG

16-Bit, Edge-Sensitive, Parallel-Input, LAM Register

A 16-bit, parallel-input, LAM register (C 76451-A17-A1/2) is available for two classes of input signals:

— single-ended, TTL, negative logic: with a high level of +2.4 to +5.5 V and a low level of 0 to +0.8 V and an input resistance of 100 Ω (C 76451-A17-A1);

— symmetrical, potential free high-level positive logic with a high level of +11 to +30 V and a low level of −28 to +5 V and an input resistance of 1800 Ω (C 76451-A17-A2).

A negative and/or a positive signal-edge generates a LAM. The sensitive polarity of an edge can be chosen bytewise by soldered—in links. A Read command will also clear LAM's after reading. Precautions are taken so as not to loose LAM's occurring during the clearance of others.

The single-width unit has a 37-pin connector on the front.

Commands:

Read LAM status register: A(12) F(1).
and clear detected LAM'S.
Test overall LAM: A(12) F(8).
Clear LAM's: A(12)·F(10)+C+Z.

Ref. Siemens AG

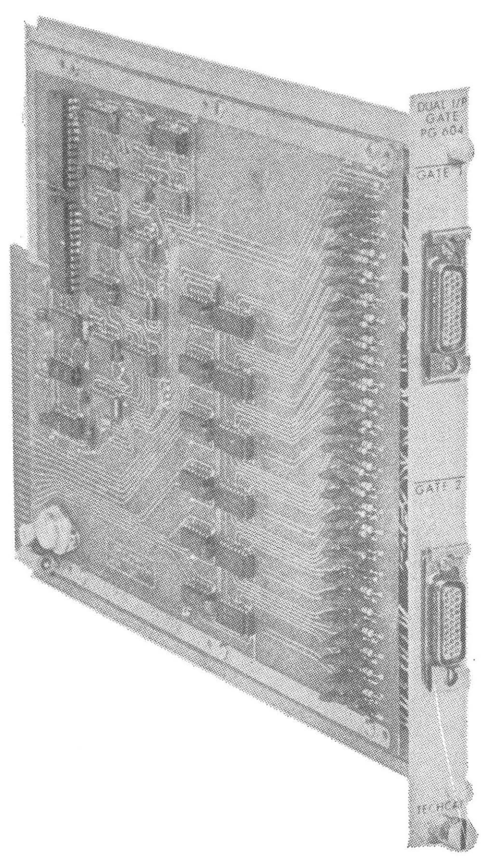
16-Channel Discriminator Coincidence Register

The LRS Model 2340B 16-channel discriminator coincidence register (DCR) has been designed primarily for large hodoscope applications where the readout of coincidence information is required in addition to normal discrimination and restandardization of raw photomultiplier pulses. It is an updated version of the already popular Model 2340A DCR, offering extremely low time-slewing and an extremely stable variable threshold. The 2340B has both fast-summing outputs for logic decisions prior to CAMAC readout and a fast clear to permit low system deadtime.

Functions used: F0, F2, F9, F25.
Double-width unit.

Ref. LeCroy Research Systems Corp.

Dual 24-Bit Parallel Input Gate



The PG-604 provides two sets of 24 external input lines which can be read onto the CAMAC Dataway. Two external strobe inputs generate a Dataway LAM response and set two 'data-received' registers. These registers are cleared when the input information is read onto the dataway.

Either LAM response may be enabled or disabled by command and either LAM status may be read onto the dataway Q line. All legal dataway commands will generate an X response and the Read command F(0) will generate a Q response.

All signal inputs and strobe inputs are integrated for approximately 1.0 μsec to suppress noise. Initialize Z will clear all registers at time S2.

Other parallel input gates of the same configuration are also available:

Single, 16-bit (PG-601), dual, 16-bit (PG-602) and single, 24-bit (PG-603).

Ref. Techcal Electronics

Dual, High-Level, Parallel-Output Register, 2×16-Bit

Two versions of a dual, parallel-output register for two 16-bit words are available: one with single-ended transistor output stages (C 76451-A9-A1) and another one with symmetrical potential free relay output stages (C 76451-A9-A2).

The single-width units are equipped with two 37-pin connectors on the front panel.

Transistorized outputs:

The levels are 30 V and ⩽ 0.4 V at 80 mA.
Clamping diodes avoid positive or negative overvoltages.
The minimum edge-transition time is ≥ 5 μsec.
The 16 collector resistors of 10K ohms are connected together to one pin of the output connector.
Max. four outputs, selectable by soldering links can be read out using a clock with a clock-time between 15 μsec and 20 nsec.

Relay outputs:

They deliver 42 V ac or dc, 0,5 Amps, 10 VA per bit via a double-ended relay working contact.

Commands:

A(0)·F(9)+C+Z, A(1)·F(9)+C+Z: clear registers
A(0)·F(16), A(1)·F(16): load registers.

Ref. Siemens AG

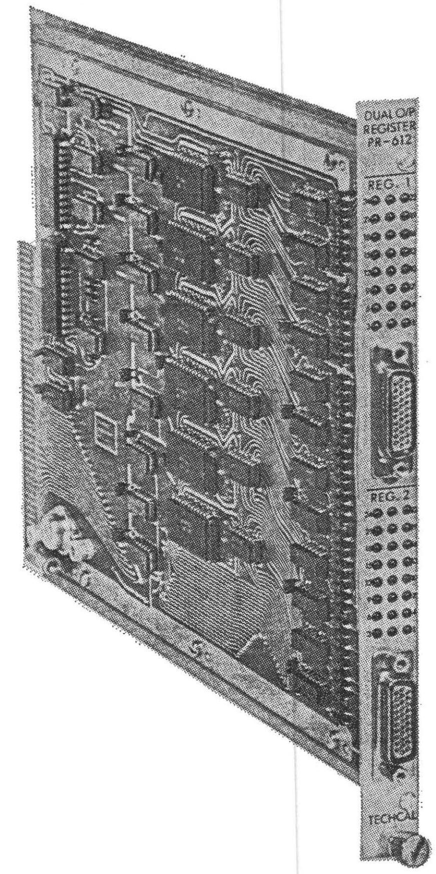
Dual, Parallel-Output Registers

The Parallel-Output Register (Model PR 612) is a single-width CAMAC module which contains 16- or 24-bit registers for output of data. The outputs are provided at front-panel connectors (31 pins). An optional front-panel LED display is available for visual display of the output data.

Data outputs are negative-true, open-collector drivers capable of sinking 48 milli. Amps (37 milli. Amps if LED display is used), at +5 volts. Should high current be required, Register Driver units are available with 280 mA sinking capability.

Data outputs are set by use of Write command F(16). Data from the write lines will be clocked into the register at S1. Existing data in a register may be read on the CAMAC Dataway with function F(0).

A fused +5 V DC, 1 Amp connection is supplied at both of the multipin front-panel connectors to power external logic.



A negative strobe-output pulse for each channel is provided to indicate when its register has been updated.

Ref. Techcal Electronics

CAMAC Memory Unit

This double width unit (MC 5202) provides sixteen 24-bit words of storage. Data may be written or read via the dataway in random or sequential mode. Push-buttons allow the memory address register to be cleared to zero and there is also a visual display of data from the memory on front panel lights.

The address register within the module is cleared to zero by Z and C. Data may be written into the memory by three methods.

- Via the Dataway, random mode.
  When the module is addressed and F(16) is used the data present on the Dataway W lines is stored in the memory at a location set by the sub-address (A) lines, in the range A(0)-A(15).
- Via the Dataway, sequential mode.
  When the module is addressed with F(20) and A(0), data is stored at the address currently indicated by the address register and the latter is then incremented.
- Via the rear connector.
  Data may be inserted into the memory indepen-

dently of the Dataway by presenting a parallel data word and a strobe pulse to the rear connector. The word is stored at the address currently indicated by the memory address register and the latter is automatically incremented.

Data may be read from the memory onto the Dataway R lines in random or sequential mode (F(0) or F(4) respectively) in similar fashion to the writing methods.

The memory address register may be set or read via the Dataway by addressing the module with A(0) and F(17) or (F1) respectively.

The module generates Q responses for all subaddresses but generates no LAM's. It may be used with a Modular 15 analogue to digital conversion system* using the rear connection allowing visual read-out of data gathered at high speed.

* Product of Micro Consultants.

Ref. Micro Consultants Ltd.

Interface Unit for CAMAC Control of precision, high-speed ADC'S (MC 4059)

The interface unit between CAMAC and the Micro Consultants range of A-D equipment (Modular 15, AN-DI 1210M) provides the full range of facilities of the analogue input system operating in a number of different configurations. A particular feature of the analogue conversion systems is the ability to revert to full manual control for system checkout. Displays are provided for data and addresses to simplify this task. The interface unit is a single-width CAMAC module and connects to the analogue conversion system via a 50-way Cannon connector mounted on the front panel.

Three operations are required to set up the system:

— Set up operating mode;
— Specify channel address(es);
— Start.
— The equipment is set into one of its operating modes by a WRITE operation on the dataway with bits allocated to select the modes:
  - Random/Sequential channel selection;
  - Single/Continuous scan of sequential channels;
  - Manual/Remote selection of addresses;
  - Manual/Remote selection of operating mode.
— Having set up the operating mode the analogue channel address(es) are set up by a single WRITE operation. If random mode has been selected a single address is specified, or for sequential mode start and finish addresses are packed into a single word and transferred.
— The start command is now given; the appropriate channel is automatically selected and the conversion carried out. A look-at-me (L) signal is generated and if more than one channel has been requested, conversion on the next channel starts.

Test software is provided to test the correct operation of the analogue input system. Complete data acquisition, recording and analysis programs can be provided to fulfil particular requirements.

Ref. Micro Consultants Ltd.

Spark Chamber Read-Out Unit

A double-width unit (model JSC 10) is equipped with the necessary logic to read out spark chambers with ferrite-core storage elements. It interrogates successively more than 4,000 groups of 32 cores by means of a 12-bit binary address with a speed of up to 1.5 μsec per group. In reply, the loaded cores are read-out, after decoding from the 32 sense lines, via the dataway together with the corresponding group address. Positive TTL levels are available for interrogation and negative TTL levels are accepted for response.

Ref. SAIP Schlumberger

Spark Chamber Read Out: PLUM-PUDDING

Two single-width CAMAC units are available for digitizing data from optical spark chambers scanned with plumbicon or vidicon cameras. One unit called Pudding (model, JPG 10) controls the transfer of data to and from a Plumbicon read-out unit, called Plum (model, JPM 10). The equipment can also be used to read magnetostrictive chambers or other data readable with a clocked time-scale.

Such a digitizing system may use any number of Plum units together with one Pudding unit per CAMAC crate. A Plum unit includes five 13-bit binary scalers and five 13-bit buffer registers.

At the end of each scan (one line of the camera), the scaler contents are transferred to the buffers, the contents of which are read-out via the Dataway at the same time as the next scan is performed.

The Pudding unit links the camera control to the CAMAC system and synchronizes the reading sequence of the Plum units Priority signals enable Plum units containing data to be selected directly by Pudding. In this way, time consuming scanning procedures through units for data read-out can be avoided.

Ref. SAIP Schlumberger

MULTIPLEXERS, CONVERTERS

Analogue Multiplexer

The Joerger Enterprises Model AM is an analogue multiplexer using reed relays to switch the signals. This unit is CAMAC compatible and meets the specification EUR 4100e, 1972. The use of reed relays allows a wide variety of signal amplitude and types to be multiplexed. Each unit is capable of switching up to 15 seperate inputs to a common connector. Double-pole relays are used so that both signal and return may be switched. Logic is provided that allows these modules to be connected together to expand the system in multiples of 15 channels. Indicators are used to show the address of the channel being used and also to tell, in a multiple-unit system, which multiplexer is active.

The Model AM operates in two modes. The up-down counter is preset from the Dataway with the address of the channel to be switched. Or in 'Off

Line' mode the address is altered by supplying up or down pulses with the two push-button switches provided.

The address of the active channel may also be read out on the Read lines together with a bit that identifies that the unit is enabled (for multi-unit operation).

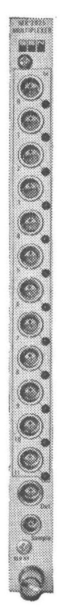
Logic is provided that will prohibit more than one channel to be active at any time even during switching or reseting.

Functions used: F0, F9, F16.

In development is a double-width 15-channel stepping-motor controller to be compatible with the Analogue Multiplexer. This combination will allow both the control and monitoring of such devices as stepping-motor controlled power supplies.
Availability: 10/72.

Ref. Joerger Enterprises

12-Input Multiplexer



This single-width CAMAC module (MX 2025) will multiplex 12 dual-pole inputs to a common-line, dual-pole output. Each channel is selected by a dual reed relay, allowing bi-directional use (i.e. 12 inputs to 1 output or 1 input to 12 outputs). There is a choice of two types of relay contacts. One for general use and one for low level inputs. (relay contacts for up to 28 V and 110 mA or 10 mA resp.) The number of channels may be increased by joining the outputs of two or more multiplexers. One additional output is available for this purpose on the rear of the unit.

The multiplexing may be executed in two modes. A write command may be used to directly select the desired channels. Alternatively, an increment command may be used to produce a multiplexing sweep, starting at channel '0' and advancing on each command. A mask register is loaded by a write command to define the channels to be skipped by the sweep. At the end of a sweep a flag is set which will produce an L-request if enabled.

When a command is given selecting one or more channels, a relay transient-timer is started. When the timer has finished, a 'SAMPLE' pulse is output and a flag is set, giving an L-request if enabled. The selected channels are displayed by indicators on the front panel, and may also be obtained by a read command.

Ref. SEN Electronique

MC 5200 Analogue I/O Mounting Card for CAMAC

MC 5200 is a printed circuit card in the CAMAC format that allows for the mounting of the following subunits.

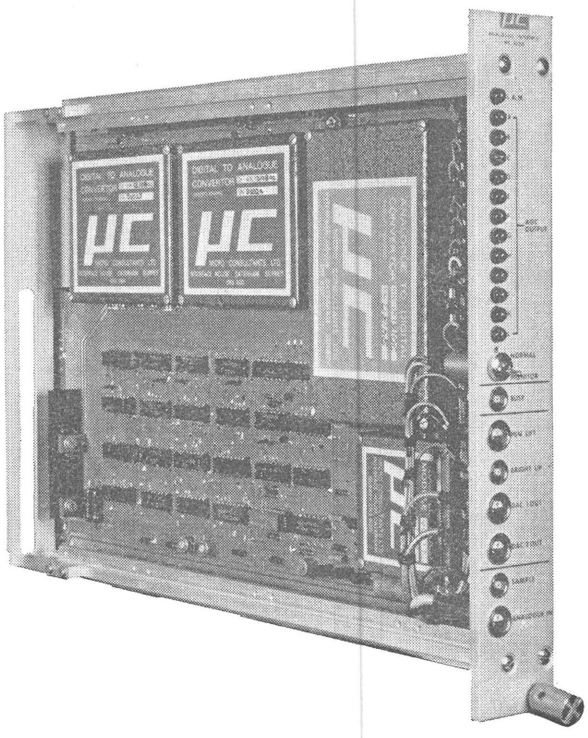
1. One SAMPLE-HOLD (MC 2172) with a 50 nS aperture time (an external input is provided to control the unit and initiate conversion of ADC below).
2. One ANALOGUE TO DIGITAL CONVERTOR (AN-DI 1210C) with 12-bit resolution and a 30 μS conversion time (±10 V—also ±5 V or 0—10 V available.)
3. Two DIGITAL TO ANALOGUE CONVERTORS (DI-AN 1210B) with 12-bit resolution and a 5 μS settling time (Output = ±10 V).

In addition there is an output suitable for bright-up or blanking, and a contact closure output for pen lift.

The logic circuits required to operate the above units from the CAMAC Dataway, together with the circuits required for the additional functions, are all provided on the mounting card.

All or any of the analogue units listed may be mounted on the card up to the full complement as shown.

MC 5200 can also be supplied mounted in a double-width CAMAC module complete with front-panel connectors and a light-emitting diode display (12 LED's for ADC, one for LAM).



Ref. Micro Consultants Ltd.

Single/Dual Analogue to Digital Converters

The Techcal Electronics' Analogue to Digital Converters are single-width CAMAC modules which provide single or dual 8, 10, or 12-bit A/D converters. (8-bit: model S or D-AD-008; 10-bit: model S or D-AD-010; 12-bit: model S or D-AD-012). The A/D converters feature 100 m ohm input impedance, 20 μsec conversion speed and high accuracy. One of three different input voltage ranges can be specified. (±10 V, ±5 V or 0 to +10 V). A conversion may be initiated either internally with dataway command, or from an external input. When an A to D conversion is made, data is strobed into register, and the LAM flip-flop is set to indicate this to the crate controller.

Ref. Techcal Electronics

1024 Channel ADC

A Wilkinson-type converter, double-width unit (model J CAN 40), converts pulse amplitudes and time-variable voltage levels up to 5V with a clock speed of 100MHz into binary numbers of up to 10-bit word length.

Data words can be transferred to a computer via the Dataway either directly or after storage in a memory buffer (model JMT 20).

Readout of data into an external memory block is also possible. Control of the conversion slope of the converter, the word length as also the signal threshold is performed manually.

Ref. SAIP Schlumberger

16000 Channel ADC

High precision analysis of pulse amplitudes and time variable voltage levels—sampled for their measurement—can be performed with two CAMAC units; a Wilkinson amplitude-to-time converter (quadruple-width, model J CAN 21C) and a time-to-digital converter operating at a clock speed of 200MHz. (double-width unit, model J CAN 21H).

14-bit binary words are read out via the Dataway directly or after storage in a buffer memory (255 words of 16 bits model JMT 20).

Via a supplementary CAMAC unit (model J CAN 20 I) data can be stored also in an external memory block (model BM 96 or BA 163). A CAMAC chronometry set can be applied for livetime control in nuclear spectrometry experiments.

Conversion slope, analogue signal thresholds and data word length are controlled manually.

Ref. SAIP Schlumberger

Dual DAC

A single-width unit delivering two analogue signal levels under program control is available. One version is equipped with a 10-bit converter (C 76451-A15-A2) and another one with a 12-bit converter (C 76451-A15-A3). 16-bit units are available on request.

The converter output stages are short circuit proof. Output configurations equivalent to a voltage or current source can be chosen with the help of soldered links.

The voltage source output delivers ± 10V into a load of $\geq 2000\Omega$; the converter settling time is 20µsec.

The current source output delivers ± 20mA into a load of $\leq 500\Omega$, the converter settling time is in this case 100µsec.

Commands:

Load converter (1,2): A(0)·F(16), A(1)·F(16).
Reset converter (1,2): A(0) F(9), A(1) F(9).

Ref. Siemens AG

CRATES, SUPPLIES

CAMAC Powered Crate

The Grenson CAMAC Powered Crate CPC/9 consists of a ventilated, 6-unit high, heavy duty CAMAC Crate, manufactured by Willsher & Quick with power supply (type CN/9) which can be removed from the rear.

The convention-cooled power supply is capable of providing 300 watts total power, available from ± 6V, ± 12V, ± 24V lines, and will function with any 45-65Hz input between 190-260V, without voltage selection being required. Each of the 6V lines gives 25A, with a total maximum of 35A from the two. Similarly 3A for each 12V line with a total of 4A for the two, and 6A for each 24V line with a total of 8A. A semi-stabilised 200V line and a 117V a.c. line are also available. All stabilised lines have adjustable overvoltage and overcurrent protection and the unit is also protected against excessive temperature rise and exceeding the total power available.

This unit which is considerably smaller and lighter than previous models, conforms to the recommended overall depth for CAMAC equipment of 525mm, The Dataway inter-connection system is provided by G.E.C./Elliott Limited. The unit also incorporates front-panel voltage and current metering, indicator lamps for 200V, overload, and over temperature, and a facility for external monitoring of all output voltages. Ventilation of the crate is achieved by 3 fans situated in a 1-unit-high ventilation tray under the bottom grill of the crate and utilising air taken in at the front of the ventilation tray.

Ref. Grenson Electronics Ltd.

COMPONENTS

GO3 - CAMAC Dataway Connector

The 43-contact, double-row version of GO3 connectors from ITT Cannon comply with CAMAC EUR 4100e (1972).

The contacts used are snap-in front-release contacts with two contact points. They are identified on the rear side of the insulators. The contact terminations can be solder eyelets, solder pins or mini-wire wrap posts. The contact spacing is on 2.54mm (.100") centres. Width of connector is under the proposed 12mm max. P.C. Boards of 1.37mm up to 1.78mm (1/16") can be used. The contact point is approximately 3.5mm before the vertical datum line.

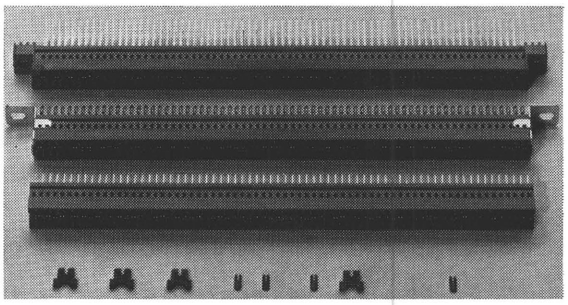
Technical Data

Materials:

Contacts	Phosphorbronze (Cu Sn)
Insulator	Diallylphthalat (Standard) Polycarbonate
Contact Finish	Hard gold plated over nickel
Operating temperature	−55/125°C (−67/257°F)
Maximum insertion and withdrawal forces	80 Newton (at a PC board of 1.78 mm)

Electrical Data

Rated current per contact	3 A
Rated voltage	330 Vrms
Test voltage	1000 Vrms
Contact resistance	≦10 mOhm
Insulator resistance	≧5×10^9 Ohm
Capacitance	<5 pF



Ref. ITT Cannon

Index to Manufacturer's News and New Products

PAPER ABSTRACTS TRANSLATIONS

A CAMAC System for Computer Control of Spectrometers
M. R. Howells, I. H. Munro and L. Naylor

Summary
This paper describes an automated control system for optical spectrometers. Each spectrometer is controlled by a CAMAC crate, and the crates are driven as a branch by a Honeywell 316 computer. Users specify spectrometer operations by typing parameters on the keyboard of a television monitor. The operations are carried out automatically, and the data are displayed.

Zusammenfassung
Es wird ein automatisiertes Steuerungssystem für optische Spektrometer beschrieben. Jedes Spektrometer wird durch einen CAMAC-Überrahmen gesteuert. Die Überrahmen bilden ein Branchsystem, welches von einem Honeywell-316-Rechner gesteuert wird. Die Parameter der vom Spektrometer auszuführenden Operationen werden über die Schreibmaschinentastatur eines Bildschirmmonitors eingegeben. Die Operationen werden automatisch ausgeführt und die Daten angezeigt.

Résumé
Ce document décrit un système de contrôle automatique de spectromètres optiques. Chaque spectromètre est contrôlé par un châssis CAMAC, les châssis sont commandés comme une branche par un calculateur Honeywell 316. Les utilisateurs spécifient les opérations des spectromètres en frappant les paramètres sur le clavier associé à un moniteur de télévision. Les opérations s'effectuent automatiquement et les données sont visualisées.

Riassunto
Si descrive un sistema di controllo automatico per spettrometri ottici. Ogni spettrometro è controllato da una cassa CAMAC e le casse sono comandate da una Interconnessione di smistamento (branch) connessa a un calcolatore Honeywell 316. Gli utenti specificano le operazioni degli spettrometri battendo i parametri sulla tastiera di un monitor video. Le operazioni vengono eseguite automaticamente con visualizzazione dei dati.

Samenvatting
Er wordt een beschrijving gegeven van een automatisch besturingssysteem voor optische spectrometers. Elke spectrometer wordt gestuurd door een CAMAC-rek waarbij deze rekken op hun beurt als een branch door een Honeywell 316 computer worden aangedreven. De door de spectrometer uit te voeren taak wordt door de gebruikers in de vorm van parameters via het toetsenbord van een monitor toegevoerd. De bewerkingen geschieden automatisch terwijl de gegevens zichtbaar worden gemaakt.

Резюме
В статьи описано состав автоматического управления оптическим спектрометром. Каждый спектрометр управляется одним крейтом КАМАК. Все крейты включены в магистраль ветви управляемой ЭВМ Honeywell 316. Команды для спектрометра заданные при помощи клавишного устройства, выполняется автоматически. Данные указываются на телевизионном мониторе.

An Airborne γ-Scintillometer
E. Mose Christiansen and P. Skaarup

Summary
A description is given of airborne instrumentation for uranium exploration. The NIM standard is used for the analogue part of the system, and the CAMAC standard for the data collecting part. The system is controlled by a programmable controller with hardware program modules.

Zusammenfassung
Es wird eine Instrumentierung beschrieben, welche an Bord von Flugzeugen für die Uransuche verwendet werden kann. Für den Teil des Systems, welcher Analogsignale verarbeitet, werden Geräte nach den NIM Spezifikationen verwendet. Für die Datenerfassung werden CAMAC-Geräte benutzt. Die Steuerung des Systems erfolgt durch eine programmierbare Steuereinheit mit Hardware-Programm-Modulen.

Résumé
On décrit l'instrumentation aéroportée destinée à la prospection de l'uranium. Le standard NIM est utilisé pour la partie analogique du système et le standard CAMAC pour l'acquisition des données. Le système est commandé par un contrôleur à programme câblé sous forme de modules.

Riassunto
Si descrive una strumentazione aerea per l'esplorazione dell'uranio. Lo standard NIM viene utilizzato nella parte analogica del sistema e quello CAMAC nella parte destinata alla raccolta di dati. Il sistema è controllato da un'unità di controllo programmabile con moduli di programma hardware.

Samenvatting
Er wordt een beschrijving gegeven van instrumentatie voor prospectie van uranium met vliegtuigen. Voor het analoge gedeelte van het systeem wordt de NIM-standaard toegepast, terwijl CAMAC wordt aangewend voor de gegevensverzameling. Het systeem wordt bestuurd door een programmeerbare regelaar met hardware programmamodulen.

Резюме
Описано состав аппаратуры для авиационного поиска урана. Аналоговая часть построена по стандарту НИМ, а собирание данных по стандарту КАМАК. Состав управляется програмным контролером с блоками постоянной памяти.

CAMAC Serial Crate Controller
Edward Barsotti

Summary
The National Accelerator Laboratory uses serial CAMAC systems to control experimental beam lines, including the two-mile long neutrino beam line. The paper describes a crate controller used on a serial branch highway, and compares it with an earlier scheme based on serial links to remote drivers for parallel branch highways.

Zusammenfassung
Das National Accelerator Laboratory verwendet CAMAC Systeme mit serieller Datenübertragung zur Steuerung von experimentellen Strahlwegen einschliesslich eines solchen von zwei Meilen Länge für Neutrinostrahlung.
Es wird eine Crate Kontrolleinheit zur Datenübertragung auf einem seriellen Branch Highway beschrieben. Diese wird verglichen mit einer früheren Konfiguration bestehend aus seriellen Koppelgliedern für Ferntreibereinheiten eines parallelen Branch Highway.

Résumé
Le «National Accelerator Laboratory» utilise des systèmes CAMAC série pour contrôler les faisceaux expérimentaux, et notamment le faisceau de neutrinos de deux miles de long. Cet article décrit un contrôleur de châssis utilisé avec une interconnexion de branche série, le comparant à un projet antérieur basé sur des liaisons série connectées à des unités de commande de branches parallèles.

Riassunto
Nel National Accelerator Laboratory vengono impiegati sistemi CAMAC serie per controllare le linee sperimentali dei fasci, compresa la linea di due miglia per il neutrino.
L'articolo descrive un'unità di controllo impiegata in una Interconnessione serie di smistamento (Serial branch highway) confrontandola con uno schema precedente basato su collegamenti serie con unità di controllo a distanza per Interconnessioni di smistamento (branch highways) parallele.

Samenvatting
Het National Accelerator Laboratory maakt gebruikt van CAMAC-seriesystemen voor de besturing van experimenten, bij stralenbundels met inbegrip van een twee mijl lang neutrinobundelkanaal. In dit document wordt een beschrijving gegeven van een reksturing voor een serie branch highway en deze wordt vergeleken met een vroegere opstelling, die was gebaseerd op serie verbindingen met op afstand geplaatste aandrijvingen voor parallele branch highways.

Резюме
National Accelerator Laboratory использует систему Камак последовательного типа для управления каналами экспериментальных пучков, включая 2-милевой канал пучка нейтрино. Описано контролер крейта использованный в последовательной магистрали ветви и сравнено это решение с раньше принятой схемой принимающей последовательную связь с драйверами управляющими параллельными магистралями ветвей.

A Modular CAMAC Interface for the Varian 620 Computer
M. Pernicka

Summary
This interface between the CAMAC Branch Highway and a Varian 620 computer consists of plug-in units in a standard CAMAC crate whose Dataway wiring is used as an Interface Highway. The modular construction allows the interface to be extended, or adapted for use with different computers.

Zusammenfassung
Die beschriebene Kontrolleinheit zwischen dem CAMAC-Branch-Highway und einem VARIAN-620-Rechner besteht aus Einschubeinheiten in einem Standard CAMAC-Überrahmen, dessen Datenweg als Kontroll-Highway verwendet wird. Aufgrund der Modularbauweise kann die Kontrolleinheit erweitert oder an verschiedene Rechner angepasst werden.

Résumé
Cet interface entre l'interconnexion de branche CAMAC et un calculateur Varian 620 se compose de tiroirs enfichables dans un châssis CAMAC standard dont l'Interconnexion est utilisée comme interconnexion d'interface. La construction modulaire permet d'étendre l'interface ou d'adapter son emploi à des calculateurs différents.

Riassunto
L'interfaccia fra l'Interconnessione di smistamento (Branch Highway) CAMAC e il calcolatore Varian 620 è costituita da unità modulari CAMAC la cui Interconnessione (Dataway) viene impiegata come Interconnessione di interfaccia. La costruzione modulare consente di ampliare l'interfaccia o di adattarla a diversi calcolatori.

Samenvatting
Deze interface tussen de CAMAC Branch Highway en een Varian 620 computer bestaat uit insteekeenheden in een CAMAC standaardsysteem waarvan de dataway bediening als Interface Highway wordt gebruikt. Door de modulaire bouw kan de interface worden uitgebreid of voor gebruik met andere computers worden aangepast.

Резюме

Интерфейс между магистралей ветви KAMAK и ЭВМ Varian 620 состоит из блоков помещенных в стандартной кассете KAMAK, которой магистраль используется как интерфейс. Модулярная конструкция позволяет розширать интерфейс или приспособлять его для других ЭВМ.

Dispositifs simples pour la visualisation de données numériques

M. Beroud, M. Egea, M. Gallice et M. Lacroix

Summary

The paper presents various simple methods of displaying digital data in CAMAC systems. These displays can be used with an on-line computer, or without a computer while setting-up an experiment preparatory to data taking. Some of these devices can also be used to implement automatic measuring systems with print-out of results.

Zusammenfassung

Es werden verschiedene einfache Verfahren zur optischen Anzeige numerischer Ergebnisse in CAMAC-Systemen angegeben, die entweder mit einem on-line-Rechner ausgeführt werden oder ohne Rechner zur Experimentvorbereitung vor einer Datenaufnahme. Einige der Einheiten können auch zur Realisierung automatischer Messeinrichtungen, welche Ergebnisse über Drucker auslesen, verwendet werden.

Résumé

On présente différentes solutions simples de visualisation de données numériques dans les systèmes CAMAC, utilisables soit avec calculateur en ligne, soit sans calculateur pendant la phase des réglages expérimentaux précédant l'acquisition de données par le calculateur. Certains de ces dispositifs permettent aussi la réalisation d'ensemble de mesures autonomes avec impression automatique des résultats.

Riassunto

Vengono presentate varie soluzioni semplici per la visualizzazione dei dati numerici nei sistemi CAMAC, da utilizzare tanto con calcolatori on-line quanto senza calcolatore nella fase delle regolazioni sperimentali che precede l'ottenimento dei dati da parte del calcolatore. Alcuni dispositivi consentono pure di ottenere gruppi di misure autonome con stampa automatica dei risultati.

Samenvatting

Dit artikel bevat een beschrijving van verschillende eenvoudige oplossingen voor het zichtbaarmaken van digitale gegevens in CAMAC-systemen, die kunnen worden gebruikt, of met een on-line computer of zonder computer in de fase van afregeling die voorafgaat aan het verzamelen van gegevens door de computer. Een aantal van deze apparaten maken tevens zelfbesturende meetopstellingen mogelijk, die de resultaten automatisch af drukken.

Резюме

В статьи представлено разные, простые методы индикации цифровых данных в системе KAMAK. Эти приспособления могут быть использованы до передачи данных при подготовке эксперимента вместе с компутером или без него. Некоторые из этих устройств могут быть применены для построения автоматических измерительных систем с печатью результатов.

CAMAC Overlay for Single-User Basic and Modification of 8-User Basic for the PDP-11

H. Halling, K. Zwoll, and W. John

Summary

This paper shows the construction of a simple BASIC I/O handler to be used with the Jülich CAMAC/PDP-11 system. A simple format has been chosen, so that a system can be set up by users who are not familiar with assembler programming.

Zusammenfassung

Es wird der Aufbau eines «BASIC-CAMAC I/O handlers» für das Jülicher PDP-11 CAMAC System beschrieben. Ein einfaches Befehlsformat unterstützt auch Anwender, die mit einer Assemblerprogrammierung nicht vertraut sind.

Résumé

Ce document décrit la réalisation d'un opérateur BASIC I/O simple qui sera utilisé avec le système Jülich CAMAC/PDP-11. On a choisi un format simple, pour qu'un système puisse être mis en place par des utilisateurs qui ne sont pas familiarisés avec la programmation en langage assembleur.

Riassunto

Il presente articolo illustra la costruzione di un semplice elaboratore BASIC I/O da impiegare con il sistema CAMAC/PDP-11 di Jülich. È stato scelto un formato semplice, per cui il sistema può essere messo a punto da utenti che non sono pratici della programmazione con l'assemblatore.

Samenvatting

In dit rapport wordt een beschrijving gegeven van de constructie van een eenvoudige BASIC I/O bediening voor gebruik met het CAMAC/PDP-11 systeem te Jülich. De voorkeur werd gegeven aan een eenvoudig formaat zodat een systeem kan worden opgebouwd door gebruikers die niet vertrouwd zijn met assemblageprogrammering.

Резюме

В статьи показано конструкцию простой программы на языке BASIC для операции ввода и вывода, которую используется для состава KAMAK — PDP-11 в Юлих. Выбрано простой формат, так чтобы потребители неознакомлены с программированием на ассемблере могли составлять системы.

A CAMAC Extension to the Assembly Language for the CII 90-10 Computer

A. Katz

Summary

Modifications to the assembly language of the CII 90-10 computer allow symbolic coding of CAMAC instructions. In order to achieve some hardware relocatability other components of the basic software (link-editor, monitor) have also been adapted for CAMAC programming. Some features of this work could easily be used with other computers.

Zusammenfassung

Modifikationen der Assemblersprache des CII 90-10-Rechners erlauben eine symbolische Kodierung von CAMAC-Befehlen. Um die Bedingungen für Veränderungen der hardware Anordnung zu erleichtern, wurden auch andere Komponenten der grundlegenden Software (Link Editor, Monitor) an die CAMAC-Programmierung angeglichen. Einige Ergebnisse der Arbeit könnten leicht bei der Verwendung anderer Rechner genutzt werden.

Résumé

Des modifications apportées au langage assembleur du calculateur CII 90-10 permettent une écriture symbolique des instructions CAMAC. Pour pouvoir modifier des adresses hardware, on a également adapté d'autres composants du software de base (éditeur de moniteur) à la programmation CAMAC. Certaines parties de cette étude pourraient aisément être utilisées sur d'autres calculateurs.

Riassunto

Le modifiche apportate al linguaggio assembler per il calcolatore CII 90-10 consentono di utilizzare codici simbolici per le istruzioni CAMAC. Per ottenere qualche rilocabilità hardware, altri componenti del software di base (Link-editor, monitor) sono stati adattati per la programmazione CAMAC. Alcune caratteristiche potrebbero essere facilmente applicabili ad altri calcolatori.

Samenvatting

Door wijzigingen aan de assembleertaal voor de CII 90-10-computer kunnen CAMAC-instructies symbolisch worden geadresseerd. Ten einde te komen tot een bepaalde soepelheid van de basissoftware (link-editor, monitor) werden andere componenten voor de CAMAC-programmering aangepast. Een aantal van de basisspecificaties hiervan kunnen gemakkelijk voor andere computers toepassing vinden.

Резюме

Модификации языка ассемблера для ЭВМ CII 90-10 позволяют кодировать символически команды KAMAK. Другие части основного программного оборудования как монитор, эдитор, были тоже адоптированы для KAMAK-а так, чтобы получить возможность перемещения блоков. Некоторые достижения могут быть легко применены в других ЭВМ.

A Focal Interrupt Handler for CAMAC

F. May, W. Marschik and H. Halling

Summary

A previously-described overlay program (FOCADAT) allows the FOCAL language to be used for handling CAMAC data and commands. This has been extended by the FOCALINT program to handle CAMAC interrupts. In this way FOCAL has been used in large control systems and also for testing CAMAC modules.

Zusammenfassung

Mit einem bereits früher beschriebenen Overlay-Programm (FOCADAT) kann FOCAL zur Verarbeitung von CAMAC-Daten und -Befehlen verwendet werden. Ein ergänzendes Programm (FOCALINT) erlaubt die Überwachung von Programmabläufen, welche von CAMAC Signalen unterbrochen werden können. Dadurch ist es möglich, FOCAL für die Steuerung grosser Systeme und zum Testen von CAMAC Einheiten zu verwenden.

Résumé

Un programme segmenté (FOCADAT), décrit précédemment, permet l'utilisation du langage FOCAL pour traiter les données et ordres d'exécution CAMAC. Il a été completé par le programme FOCALINT destiné à traiter les interruptions CAMAC. Le langage FOCAL a pu ainsi être appliqué à de vastes systèmes de contrôle, ainsi qu'au test de modules CAMAC.

Riassunto

Un programma di «overlay» già descritto in precedenza (FOCADAT) consente di impiegare il linguaggio FOCAL per il trattamento dei dati e delle istruzioni CAMAC. Il programma FOCALINT ha aumentato tali possibilità in modo da trattare anche l'interruzione CAMAC. Pertanto il FOCAL è stato impiegato in sistemi di controllo di grandi dimensioni e per provare i moduli CAMAC.

Samenvatting

Een reeds vroeger beschreven overlay programma (FOCADAT) maakt het mogelijk de FOCAL-taal toe te passen voor de verwerking van CAMAC-gegevens en instructies. Deze mogelijkheid is uitgebreid door het FOCALINT-programma voor behandeling van CAMAC ingrepen. Op deze wijze kon FOCAL worden aangewend voor grote besturingssystemen en voor het testen van CAMAC modules.

Резюме

Раньше описанная программа FOCDAT позволяет применить язык FOCAL для манипуляции данными и командами KAMAK. Программа FOCALINT расширяет эти возможности на обработку прерываний. В таком режиме FOCAL был использован в больших системах управления, а тоже для проверки блоков KAMAK.

Specifications for Standard CAMAC Subroutines

Richard F. Thomas, Jr.

Summary

This report has been prepared under the guidance and sponsorship of the CAMAC Software Working Group of the USAEC NIM Committee. It describes six FORTRAN-compatible subroutines allowing CAMAC operations to be specified in a high-level programming language. The fundamental CAMAC operations and standard modes of block transfers are implemented.

Zusammenfassung

Die Ausarbeitung des vorliegenden Berichts wurde von der Arbeitsgruppe "CAMAC-Software" des USAEC-NIM-Komitees unterstützt und gefördert. Sechs Fortran-kompatible Unterprogramme werden beschrieben, welche CAMAC-Operationen in einer hochentwickelten Programmiersprache spezifizieren. Die grundlegenden CAMAC-Operationen und die standardisierten Methoden zur Übertragung von Datenblöcken wurden berücksichtigt.

Résumé

Ce rapport a été préparé sous la direction et la responsabilité du Groupe de travail Software CAMAC du Comité NIM de l'U.S.A.E.C. Il décrit six sous-programmes compatibles FORTRAN qui permettent d'exprimer les opérations CAMAC dans un langage de programmation évolué telles que les opérations CAMAC de base et les modes standards de transferts de bloc.

Riassunto

Il presente rapporto è stato preparato sotto la guida e l'assistenza del gruppo di lavoro per il Software CAMAC del Comitato americano AEC NIM. Esso descrive 6 subroutine compatibili con il FORTRAN, e consente di specificare operazioni CAMAC in un linguaggio di programmazione ad alto livello. Il programma comprende le operazioni fondamentali CAMAC e il sistema standard di trasferimento in blocco.

Samenvatting

Dit rapport werd uitgewerkt onder leiding van de werkgroep "CAMAC Sofware" van het NIM-comité van de USAEC. In dit rapport wordt een beschrijving gegeven van zes met FORTRAN verenigbare subprogramma's die het mogelijk maken CAMAC-bewerkingen in een geavanceerde programmataal te specificeren. De basisbewerkingen met CAMAC en de standaardwerkwijzen voor bloktransferten kunnen hierbij worden toegepast.

Резюме

Статью подготовлено под руководством и патронатом рабочей группы KAMAK по програмировании Комитета НИМ. Описано шесть подпрограмм языка фортран позволяющих представить операции KAMAK на языке программирования высшего уровня. Были осуществлены основные операции KAMAK и стандартные режимы блочной передачи.

The Hold and Pause Modes for CAMAC Block-Transfers

F. Iselin, B. Löfstedt and P. Ponting

Summary

The Pause mode of block transfer to or from a CAMAC module can be used when there is uncertainty about both the block length and the readiness of the module. Alternatively, the standard Stop mode, which deals with block length, can be augmented by the Hold technique.

Zusammenfassung

Der 'Pause Mode' für die Datenübertragung in Blöcken von oder zu einer CAMAC Einheit kann angewendet werden wenn die Blocklänge der zu übertragenden Daten und ausserdem der momentane Betriebszustand einer Einheit nicht bekannt sind.
Erweiterte Möglichkeiten bietet der 'Hold Mode' bei unbekannter Blocklänge und der Anwendung des standardisierten 'Stop Mode'.

Résumé

Le mode «Pause» peut être utilisé pour le transfert de bloc d'informations à destination ou en provenance d'un module CAMAC lorsqu'on ne sait pas si l'information est prête et que l'on ne connaît pas la longueur du bloc. Une autre méthode est le mode «Stop» standard, prévu pour une longueur de bloc variable, utilisé avec le «Hold».

Riassunto

Il modo «Pause» per il trasferimento in blocco da o verso un modulo CAMAC può essere utilizzato quando non si conoscono con esattezza la lunghezza del blocco e la disponibilità del modulo. Inoltre il normale «Stop mode» che è legato alla lunghezza del blocco può essere migliorato tramite la tecnica «Hold»,

Samenvatting

De pauseer modus voor bloktransferten van of naar een CAMAC moduul kan worden gebruikt wanneer onzekerheid bestaat over de bloklengte en de gereedheid van de moduul. Als alternatief kan de standaardstop modus die te maken heeft met de bloklengte worden versterkt door toepassing van de vasthoud techniek.

Резюме

Режим «паузы» для блочной передачи из, или к блоку KAMAK можно использовать в случае, когда длина блока или готовность устройства сразу неизвестные. Альтернативно нормальный режим «стоп» контролирующий длину блока можно разширить используя технику сигнала «Hold».

Universally Applicable CAMAC Modules

Dietrich Reimer and Ingo Liebig

Summary

Differing specifications for external connections often lead to families of CAMAC modules, with many common features and some specific features such as external signal standards. The development of such families of modules can be rationalised by using sub-modular construction and internal patching, as described in this paper.

Zusammenfassung

Unterschiedliche Spezifikationen für externe Anschlüsse führen häufig zu CAMAC-Modulfamilien, für welche die einzelnen Einheiten viele gemeinsame und einige spezifische Charakteristiken haben, z.B. in Bezug auf Regeln für externe Signale. Die Entwicklung solcher Modulfamilien kann durch die beschriebene Submodularbauweise und interne Anpassung von steckbaren Verbindungen rationalisiert werden.

Résumé

Des différences de spécifications concernant les connexions externes donnent souvent naissance à des familles de modules CAMAC caractérisées par un grand nombre de fonctions communes mais aussi quelques éléments spécifiques, tels que les normes de signaux externes. Il est possible de rationaliser le développement de telles familles de modules grâce à la construction de sous-modules reliés par connexions internes, comme indiqué ici.

Riassunto

Le diverse caratteristiche delle connessioni esterne portano spesso a famiglie di moduli CAMAC che presentano molti aspetti comuni e singoli aspetti specifici come le caratteristiche dei segnali esterni. Lo sviluppo di tali famiglie di moduli può essere razionalizzato utilizzando una costruzione sub-modulare con una possibilità di connessioni interne come descritto nell'articolo.

Samenvatting

Verschillende specificaties voor externe verbindingen leiden vaak tot CAMAC moduleseries, die naast vele gemeenschappelijke kenmerken enkele specifieke kenmerken vertonen, zoals b.v. ten aanzien van de externe standaardsignalen. De ontwikkeling van dergelijke moduleseries kan door de aangegeven bouwwijze met behulp van sub-modulen en interne aanpassing worden gerationaliseerd.

Резюме

В следствие различных спецификации для внешных соединений с блоками часто возникают семейства похожих блоков отличающихся некоторыми специфическими свойствами. Разработку таких семейств блоков можно рационализировать применением субмодулярной конструкции с внутренными соединениями как описано в статьи.

Considerations in the Design of CAMAC-Oriented Processors

Charles E. Cohn

Summary

This paper considers some design features for a CAMAC-oriented processor. This could yield significant hardware and software economies compared with superimposing a CAMAC system on a processor that is not especially well adapted to it.

Zusammenfassung

Es werden Entwicklungskriterien für eine CAMAC orientierte Datenverarbeitungseinheit erörtert. Verglichen mit den üblichen Ausführungsformen solcher Einheiten, welche als Teil von Rechnersystemen an CAMAC angeschlossen werden, können speziell angepasste Datenverarbeitungseinheiten zu einer bedeutenden Verringerung des Hardware und Software Aufwandes führen.

Résumé

Ce document examine quelques caractéristiques conceptuelles d'un calculateur orienté CAMAC. Cette solution pourrait s'avérer, tant en hardware qu'en software, beaucoup plus économique que l'association d'un système CAMAC à un calculateur qui n'a pas été prévu pour cela.

Riassunto

Vengono esaminati alcuni aspetti del progetto di elaboratori predisposti per il CAMAC che potrebbero consentire notevoli economie di hardware e di software rispetto all'impiego di un sistema CAMAC in connessione con un elaboratore che non sia stato appositamente adattato a tale sistema.

Samenvatting

In dit artikel worden enkele beschouwingen gewijd aan bijzonderheden van het ontwerp van een op CAMAC gerichte verwerkingseenheid. Dit zou een aanzienlijke besparing kunnen opleveren inzake hardware en software ten opzichte van het gebruik van een CAMAC-systeem met een verwerkingseenheid die hiervoor niet speciaal is aangepast.

Резюме

В статьи рассмотрено некоторые проектированное свойства процессора ориентированного на систему KAMAK. Это позволит сэкономить много из электронного и програмного оборудования по сравнении с применением системы KAMAK для работы с обычным процессором.

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

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

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

CAMAC PRODUCT GUIDE

(Products available up to January 25, 1973)

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 Product Reference compiled by CERN-NP-EL II from manufacturers' catalogues, advertisements and written communications available to them on 25th January 1973.

The number of items of commercially available CAMAC equipment is still increasing, the current list containing some 160 more items than in issue No. 5 of the Bulletin. 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.

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

The general arrangement of the equipment list is based on a classification according to the main operational application of each item. This has the advantage that the main classes of unit (such as scalers, I/O registers and gates, crates, etc.) are grouped together. Some other units are difficult to classify using the available information, and readers are therefore advised to search under several categories.

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

BRANCH HIGHWAY RELATED SYSTEM UNITS
(Computer Couplers, Crate Controllers, Terminations)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	INTERFACE/SYSTEM CONTROLLER TO HP2100, 2114, 2115, 2116	2201	BORER	NA	/71	(4)
	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)
	INTERFACE FOR VARIAN 620I/L/F COMPUTER (PROGR,SEQUENT AND BLOCK TRANSFERS)	2204	BORER	NA	/72	
	PDP-11 CAMAC CONTROLLER(SEQUENTIAL READ/WRITE,24 GRADED-L INTERRUPT DIRECTLY)	CA 11-A	D E C	NA	/71	(2)
	PDP-15 CAMAC INTERFACE(18/24BIT,PROGR, SEQUENT ADDR AND BLOCK TRANSFER MODES)	CA 15 A	D E C	NA	/71	(1)
	PDP-9 CAMAC INTERFACE (SOMEWHAT MODIFIED CA 15 A)	CA 15 A/PDP-9	D E C	NA	/71	
N	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	
	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			
C	EXECUTIVE CONTROLLER (TRANSFORMS STANDARD CRATE INTO SYSTEM CRATE)	MX-CTR-2		2	/72	
C	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			
N	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			
C	PROGRAM TRANSFER INTERFACE	PTI-11 C/D		3	/72	
	UNIBUS TERMINATION UNIT	TRM-11		1	/72	
C	SYSTEM INTERFACE BUS (LINKS UNIBUS TO ALL SI SOURCE UNITS FORMING INTERFACE)	SI-BUS-X11			/72	
C	INTERRUPT VECTOR GENERATOR (ADDS AUTONOMOUS ENTRY OF GL-DERIVED INTERRUPTS)	IVG-11		1	/72	
N	DIRECT MEMORY ACCESS INTERFACE (ADDS MULTICHANNEL DMA,NEEDS AUTONOMOUS CTRL)	DMA-11		1	06/73	
C	NOVA/SUPERNOVA SYSTEM INTERFACE, COMPR		GEC-ELLIOTT			
C	PROGRAM TRANSFER INTERFACE	PTI-N C/D		3	/72	
	I/O BUS TERMINATION UNIT	TRM-N		1	/72	
C	SYSTEM INTERFACE BUS	SI-BUS-XN			/72	
	INTERRUPT VECTOR GENERATOR	IVG-N		1	04/73	
N	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	
N	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	
N	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	
C	SYSTEM CRATE TEST UNIT (TWO-COMMAND TEST UNIT FOR CHECKING SYSTEM CRATE SYSTEMS)	SC-TST-1	GEC-ELLIOTT	3	/72	
C	DISPLAY DRIVER(CONTROLS 72A DISPLAY, ALSO CRATE CTR AND BRANCH DRIVER)	72A	JORWAY	5	/71	
	PDP-11 BRANCH DRIVER	KS 0011	KINETIC SYSTEMS	NA	/71	(4)
	BRANCH DRIVER (24BIT, PROGR, SEQUENT AND BLOCK TRANSFER MODES, MAX 7 CRATES)	5400	LABEN	4		
	H316/DDP516 CAMAC BRANCH HIGHWAY DRIVER (MEETS EUR 4600 SPECS)		MICRO CONSULTANTS	NA		

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	PDP 11 INTERFACE AND BRANCH DRIVER SYSTEM, COMPRISING		NUCL. ENTERPRISES			
	16-BIT CONTROLLER	9030		3	/72	
	BRANCH INTERFACE	9031		2	/72	
C	PDP 11 INTERFACE CARD (USED IN CONJUNCTION WITH 9030)	9032			/72	
N	INTERFACE CARD FOR DEC PDP 8 SERIES	9034	NUCL. ENTERPRISES		04/73	
N	INTERFACE FOR K202 COMPUTER	100	POLON	3	05/73	
	INTERFACE CAMAC-PDP 11 (PROGRAMMED,BLOCK TRANSFER AND SEQUENTIAL ADDR MODES)	ICP 11/CP 11 A	SAIP-CRC	NA	/71	(4)
	NOVA COMPUTER TO CAMAC MASTER BRANCH HIGHWAY DRIVER (ONE TO THREE BRANCHES)	MC-2010	TECHCAL	4	/71	
	SLAVE BRANCH HIGHWAY DRIVER	MC-2016		2	/71	
	MICROPROGRAMMED BRANCH DRIVER FOR PDP-11	MBD-11	TMA ELECTRONICS	NA		(5)
	NOVA BRANCH DRIVER		TMA ELECTRONICS	NA		(5)
N	PDP-11 SYSTEM CONTROLLER	C-CSC-11	WENZEL ELEKTRONIK	2	/72	
C	CRATE CONTROLLER /ESONE TYPE A1/ (CONFORMS TO EUR4600 SPECS)	1502	BORER	2	/72	
N	ESONE TYPE A-1 CRATE CONTROLLER (CONFORMS TO EUR 4600 SPECS)	CC 2405	GEC-ELLIOTT	2	01/73	
	CRATE CONTROLLER TYPE A-1 (CONFORMS TO EUR4600 SPECS)	CCA-1	JOERGER	2	/72	(5)
C	BRANCH CRATE CONTROLLER/TYPE A-1 (CONFORMS TO EUR 4600 SPECS, 1972)	70	JORWAY	2	/72	
	CRATE CONTROLLER	3901	KINETIC SYSTEMS	2	/72	
	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	
C	CONTROLEUR DE CHASSIS TYPE A-1 (CONFORMS TO EUR4600 SPECS)	J CRC 51	SAIP-CRC	2	/72	(1)
C	A-1 CRATE CONTROLLER (CONFORMS TO EUR4600 SPECS, INCL CERN SPEC HOLD LINE)	ACC 2034	SEN	2	/72	
C	CRATE CONTROLLER A (CONFORMS TO EUR 4600 SPECS)	C 72451-A1446-A2	SIEMENS	2	/70	(1)
	TYPE A-1 (ESONE) CRATE CONTROLLER	CC-A1	TECHCAL	2	/72	(6)
	CAMAC CRATE CONTROLLER TYPE A-1 (CONFORMS TO EUR4600 SPECIFICATIONS)	CC101	EG+G	2	/72	
	TERMINATION UNIT	1591	BORER	2	/71	
	TERMINATOR MODULE (BRANCH HIGHWAY TERMINATOR)	TCC24	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 (LED DISPLAY WITH MEMORY)	BT 6502	GEC-ELLIOTT	2	/72	
	BRANCH TERMINATION UNIT (NON INDICATING)	BT 6503	GEC-ELLIOTT	2	/72	
C	VISUAL BRANCH TERMINATOR (STORES AND DISPLAYS ON LEDS BRANCH SIGNALS)	VBT	JOERGER	2	/72	(6)
	BRANCH TERMINATOR	BT	JOERGER	2	/72	
	BRANCH TERMINATION	50	JORWAY	2	/71	
N	BRANCH TERMINATION WITH BRANCH DISPLAY	51	JORWAY	2	/72	
	TERMINAISON DE BRANCHE CAMAC	J BT 20	SAIP-CRC	2	/71	
C	CRATE CONTROLLER BUS TERMINATOR FOR A-1 CRATE CONTROLLER	BT 2042	SEN	1	/72	
C	BRANCH TERMINATION UNIT (WITH INDICATOR)	C 72451-A10-A1	SIEMENS	NA		(3)
	BRANCH HIGHWAY TERMINATOR	BT-001	TECHCAL	1	/72	
C	DIFFERENTIAL BRANCH EXTENDER (FOR EXTENDING BRANCHES UP TO 3 KM)	DBE 6501	GEC-ELLIOTT	2	/71	
N	TRANSMISSION LINE DRIVER		POLON	0		
	BRANCH HIGHWAY TRANSCEIVER FOR LONG DISTANCE TRANSMISSION	J BHT 10	SAIP-CRC	2		(4)

DATAWAY RELATED SYSTEM UNITS
(Computer Couplers, Controllers)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	SINGLE CRATE CONTROLLER TO HP (CERN TYPE 066)	1531	BORER	2	/72	
C	CRATE CONTROLLER/PDP11 UNIBUS INTERFACE	1533A	BORER	2	/72	(4)
N	NPR CONTROLLER FOR DMA TO PDP11 E.G. VIA 1533A CRATE CONTROLLER/INTERFACE	1542		NA	05/73	
	UNIBUS EXTENDER, TRANSMITTER	1594	BORER	2	/72	
	RECEIVER (FOR DISTANCES UP TO 200 METRE OR MORE)	1595		2	/72	
N	SINGLE CRATE SYSTEM CONTROLLERS(SEE EXECUTIVE SUITE, BRANCH RELATED UNITS)		GEC-ELLIOTT			
C	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	
	UNIBUS CRATE CONTROLLER PDP-11	3911	KINETIC SYSTEMS	2	/72	
N	AUTONOMOUS CONTROLLER FOR PDP 11	9033	NUCL. ENTERPRISES	2	04/73	
N	CRATE INTERFACE FOR MULTI 8	J CM 8	SAIP-CRC	2	/72	
N	CRATE INTERFACE FOR PDP 8/I	J CPDP 8/I	SAIP-CRC	3	04/73	
C	CRATE CONTROLLER 320	C 72451-A6-A1	SIEMENS	3	/72	
N	CRATE CONTROLLER 404	C 76451-A7-A1	SIEMENS	0		
	CRATE CONTROLLER TYPE D (CONFORMS TO EUR 4100, USED WITH DO 280 COMPUTER SYSTEM)	DO 200-2901	DORNIER	2	/71	
	CRATE CONTROLLER FOR NOVA COMPUTER	CC 2023A/B	SEN	2	/70	
	CRATE CONTROLLER BUS TERMINATOR FOR CC 2023A/B (ONE PER SYSTEM)	BT 2022		1	/71	
	DATAWAY CONTROLLER DDP-516(PART OF 7000-SER SYSTEM WITH EXT CONTROL HIGHWAY)	7022-1	NUCL. ENTERPRISES	4	/70	
	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	
N	DATA BREAK MODULE (USED WITH 7048)	CS 0009		1	/72	
N	IBM 1130 INTERFACE SYSTEM (FOR HIGH SPEED DATA ACQUISITION, PROCESSING AND INTERACTIVE GRAPHICS, COMPRISING	WDV 3300	WDV			
N	INTERFACE CONTROL UNIT	WDV 1002		0		
N	EXTENSION MODULE (MULTIPLEXER)	WDV 1060		0		
N	PRIORITY MODULE	WDV 1008		0		
N	MULTIPLEXER (DATA)	WDV 1133		0		
N	THE WDV 3300 INTERACTIVE GRAPHICS SYSTEM COMPRISING		WDV			
N	DISPLAY UNIT	WDV 1855		0		
N	LIGHT PEN	WDV 1851		0		
N	GRAPHIC DATASENSOR	WDV 1833 G		0		

OTHER SYSTEM UNITS

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
C	START-STOP CONTROLLER(START,STOP,RESET, MANUAL OR DATAWAY CONTROL, 100HZ CLOCK)	FHC 1304	BF VERTRIEB	1	/71	(1)
	SYSTEM 3000 CONTROLLER (FOR DISTRIBUTED INTERFACE SYSTEM, SERIAL MODE)	1551	BORER	2	/72	
	SYSTEM 3000 CONTROLLER (FOR DISTRIBUTED INTERFACE SYSTEM, PARALLEL MODE)	1552	BORER	2	/72	
	COMMANDE *ARRET-MARCHE* (START-STOP UNIT ,START,STOP,CLOCK, AND GATE OUTPUTS)	J AM 10	SAIP-CRC	1	/71	
	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	
N	INDEPENDENT PROCESSER	130	POLON	3	10/73	
	DIGITAL CONTROL MODULE(BIDIRECTIONAL CON TROL VIA R/W-LINES OF FOUR 4BIT DEVICES)	TC-0440	TECHCAL	2	/71	
	DIGITAL CONTROL MODULE(BIDIRECTIONAL CON TROL VIA R/W-LINES OF FOUR 8BIT DEVICES)	TC-0840	TECHCAL	2	/71	
	LAM GRADER (24 BIT MASK REGISTER, PLUG-IN PATCH BOARD, CERN 064)	LG 2401	GEC-ELLIOTT	1	/72	

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

MANUAL CONTROLLERS AND TEST EQUIPMENT

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	MANUAL CRATE CONTROLLER	GFK-LEM	EISENMANN	8	/71	
	MANUAL DATAWAY CONTROLLER	7024-1	NUCL. ENTERPRISES	8	/70	
	CONTROLEUR MANUEL DE CHASSIS (MANUAL TEST MODULE)	J CMC 10	SAIP-CRC	8	/71	(1)
	DISPOSITIF DE CONTROLE MANUEL DE DATAWAY (MANUAL CONTROLLER/DISPLAY SYSTEM)	D AI 10	SAIP-CRC		/71	
	TIROIR DE PRISE D INFORMATION (INTERFACE TO DATAWAY)	J DA 10		1		
	CHASSIS DE CONTROLE ET AFFICHAGE (CONTROL AND DISPLAY CHASSIS)	C AI 10		NA		
	CHASSIS DE CONTROL MANUEL DE BRANCHE (COMPR TYPES CCOB10/TCMB10/TIC10/TIC20)	C CMB 10	SAIP-CRC	NA	/71	(1)
	MANUAL 24 BIT CRATE CONTROLLER	MCC-240	TECHCAL	2	/72	(5)
	ADDRESS SCANNER (MANUAL CONTROL OF CRATE OPERATIONS)	C-AS-20	WENZEL ELEKTRONIK	2	/72	
	DATAWAY TEST MODULE (TESTS DATAWAY FOR OPEN LINES AND SHORTS)	DT086	EG+G	3	/72	
	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)
C	SYSTEM TEST UNIT (FOR EXECUTIVE SUIT SYSTEM CONFIGURATION, SEE MX-CTR-2)	SC-TST-1	GEC-ELLIOTT	3	/72	
C	DYNAMIC TEST CONTROLLER (GENERATES ALL POSSIBLE CAMAC COMMANDS IN SINGLE CRATE)	TC 2403	GEC-ELLIOTT	3	/71	
	MANUAL CRATE CONTROLLER	MCC	JOERGER	5	/72	
C	MANUAL BRANCH DRIVER (FOR TESTING TYPE A SYSTEMS)	MBD	JOERGER	5	/72	(6)
	DYNAMIC TEST CONTROLLER (2 SIMULT TRANSF SINGLE,STEP-BY-STEP AND CONTINUOUS MODE)	C 108	RDT	8	/71	(4)
C	TEST MODULE FOR CRATE CONTROLLER AND DATAWAY	DTM 2040	SEN	1	/72	
	PDP-11 SIMULATOR		TMA ELECTRONICS	NA		(5)
	CAMAC DATAWAY DISPLAY (DATAWAY SIGNAL PATTERN STORED/DISPLAYED,2 TEST MODES)	1801	BORER	1	/71	(1)
C	DATAWAY TEST MODULE(FULL DATAWAY MONITOR WITH INTERNAL STORAGE AND LED DISPLAY)	DTM 3	GEC-ELLIOTT	1	/72	
N	DATAWAY MEMORY (DISPLAY + READABLE REGISTER)	C 340	INFORMATEK	1	/72	
C	DATAWAY DISPLAY (STORES AND DISPLAYS DATAWAY SIGNALS, FARWQXCIZS1S2BP1P2)	DD	JOERGER	1	/72	(6)
	DATAWAY DISPLAY	3290	KINETIC SYSTEMS	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)
N	DATAWAY DISPLAY	C 76451-A16-A1	SIEMENS	1		(6)
	DATAWAY DISPLAY MODULE	DD-001	TECHCAL	1	/72	(5)
N	DATAWAY DISPLAY	C-DI-24	WENZEL ELEKTRONIK	1	/72	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR

SERIAL INPUT MODULES (Scalers)

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	
	ECHELLE BINAIRE 24 BITS(SCALER,20MHZ NIM OR 10MHZ TTL I/P,EXT INHIBIT IN,OVF O/P)	J EB 10	SAIP-CRC	1	/71	
	MINISCALER (2X16BIT,30MHZ,SEPARATE GATES AND EXTERNAL RESET,NIM LEVELS)	002	NUCL. ENTERPRISES	1		
	MINISCALER (2X16BIT,30MHZ,SEPARATE GATES AND EXTERNAL RESET,NIM LEVELS)	1002	BORER	1	/69	
	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	
N	DUAL 24 BIT BINARY SCALER (15MHZ, NIM OR TTL INPUTS)	FHC 1313	BF VERTRIEB	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	
	DUAL 24-BIT COUNTING REGISTER	C-DS-24	WENZEL ELEKTRONIK	1	/72	
	MICROSCALER (4X16BIT,2X32BIT SELECTABLE, 25MHZ,COMMON GATE,NIM LEVELS)	1003	BORER	1	/69	
	QUAD CAMAC SCALER (4X16BIT OR 2X32BIT, 40MHZ)	1004	BORER	1	/72	
C	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	
C	QUAD 40 MHZ SCALER (4X16BIT,2X32BIT SELECTABLE,INDIV HI-Z INHIBITS, NIM)	SR 1606	GEC-ELLIOTT	1	/71	
	SERIAL REGISTER (4X16BIT,2X32BIT SELECTABLE,100MHZ,COMMON GATE,NIM LEVELS)	SR 1608	GEC-ELLIOTT	1	/71	
	MICROSCALER (4X16 BIT,25MHZ,OPTIMIZED INPUT,3 NSEC,GIVES TYP 80MHZ COUNTING)	003-4	NUCL. ENTERPRISES	1	/71	(5)
	QUAD SCALER	9015	NUCL. ENTERPRISES	0	/71	(5)
	MICROSCALER(4X16BIT,2X32BIT SELECTABLE, 25MHZ,COMMON GATE,NIM LEVELS)	C 102	RDT	1	/71	
	ECHELLE BINAIRE 4 X 16 BITS(SCALER,30MHZ 2X32BIT SELECTABLE,COMMON GATE,NIM/TTL)	J EB 20	SAIP-CRC	1	/71	
	FOUR-FOLD SCALER (4X16BIT,2X32BIT SELECTABLE,50MHZ,COMMON GATE,NIM LEVELS)	4 S 2003/50	SEN	1	/69	
	FOUR-FOLD SCALER(4X16BIT,2X32BIT SELECTABLE,100MHZ,COMMON GATE,NIM LEVELS)	4 S 2003/100	SEN	1	/70	
C	FOUR-FOLD CAMAC SCALER (4X16BIT,40MHZ, ONE 50 OHMS,ONE HI-Z NIM I/P PER SCALER)	4 S 2004	SEN	1	/70	
C	TIME DIGITIZER(4X16BIT,CLOCK RATE 70/85MHZ, WITH CENTER FINDING LOGIC)	TD 2031	SEN	1	/72	
	TIME DIGITIZER (4X16BIT,CLOCK RATE 70/85MHZ,NIM LEVELS)	TD 2041	SEN	1	/72	(4)
	QUAD 25 MHZ SCALER (4X16BIT,2X32BIT SELECTABLE,COMMON GATE,NIM LEVELS)	QS-003/25	TECHCAL	1	/71	
	QUAD 70 MHZ SCALER (4X16BIT,2X32BIT SELECTABLE,COMMON GATE,NIM LEVELS)	QS-003/70	TECHCAL	1	/71	
	QUAD 100 MHZ SCALER (4X16BIT,2X32BIT SELECTABLE,COMMON GATE,NIM LEVELS)	QS-003/100	TECHCAL	1	/71	
	QUAD SCALER (4X24BIT,150/125MHZ,DATAWAY AND/OR EXT FAST INHIBIT,NIM LEVELS)	S424B	EG+G	1	/71	
	QUAD 100 MHZ SCALER (4X24BIT, WITH CARRY AND 16TH/24TH BIT OVF OUT, NIM SIGNALS)	S1	JOERGER	1	/72	(5)
	QUAD 100MHZ SCALER (4X24BIT,DISCR LEVEL -0.5V,TIME-INTERVAL APPL,NIM INHIB I/P)	84	JORWAY	1	/71	(2)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	QUAD 100 MHZ SCALER(4X16/24BIT,-0.5V I/P THRESHOLD,COMMON EXT FAST INHIBIT,NIM)	2550B	LRS-LECROY	1	/70	
	QUAD COUNTING REGISTER(4X24BIT,NIM INPUT TTL INHIBIT IN,TTL CARRY AND OVF OUT)	709-2	NUCL. ENTERPRISES	1	/71	
N	DUAL 24 BIT BCD SCALER (15MHZ, NIM OR TTL INPUTS)	FHC 1311	BF VERTRIEB	1	/72	
N	DUAL 100 MHZ-6 DECADE BCD SCALER	C 350	INFORMATEK	1	02/73	
	DOUBLE ECHELLE 6 DECADES-100 MHZ A AFFICHAGE REPORTE(SCALER WITH REG O/P)	J EA 10	SAIP-CRC	1	/71	
N	ECHELLE 6 DECADES DCB (DECADE SCALER, 25 MHZ, BUILT-IN DISPLAY)	J EA 20	SAIP-CRC	1	04/73	
	QUAD SIX-DECADE COUNTER WITH VARIABLE THRESHOLD AND INPUT FILTER, SLOW)	1007	BORER	1	/72	(4)
	QUAD BCD SCALER (4X6 DECADES,30MHZ)	9021	NUCL. ENTERPRISES	0	/71	
	OCTAL SCALER (12BITS,8 INPUTS,50MHZ,EACH SCALER GIVES EXT INHIBIT,NIM LEVELS)	S812	EG+G	1	/71	
	DUAL INCREMENTAL POSITION ENCODER (2X20 BIT X-Y DIGITIZATION BY UP-DOWN COUNTER)	2IPE 2019	SEN	1	/71	
N	DIGITAL WINDOW DISCRIMINATOR (WITH 128X16BIT BUFFER, PARALLEL + SERIAL I/P)	DWD 2046	SEN	1	/72	

PRESET COUNTING MODULES (Scalers, Timers)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	PRESET COUNTING REGISTER (16BIT,10MHZ, NIM/TTL I/P,TTL INHIB + O/P,DATAWAY SET)	7039-1	NUCL. ENTERPRISES	1	/70	
	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	
	REAL TIME CLOCK (NEEDS EXT CLOCK,MAX 100 DAYS PERIOD WITH 1HZ PULSES IN,TTL I/O)	712	NUCL. ENTERPRISES	1	/71	
N	PRESETTABLE COUNTER (24BIT)	420	POLON	1	10/73	
N	DOUBLE ECHELLE 24 BITS (PRESET 2X24BIT SCALER, 100 MHZ COUNTING)	J EP 30	SAIP-CRC	1	04/73	
C	SCALER 50 MHZ (12/16/18/24BIT,PRESET WITH OVF LINE,CONSTANT DEADTIME)	C 72451-A3-A1	SIEMENS	1	/72	
C	SCALER 300 MHZ (12/16/18/24BIT,PRESET WITH OVF LINE,CONSTANT DEADTIME)	C 72451-A11-A1	SIEMENS	1	/72	
	PRESETTABLE SCALER (24BIT)	C-PS-24	WENZEL ELEKTRONIK	1	/72	
C	24BIT BCD PRESET-SCALER (12MHZ, NIM OR TTL INPUTS,MANUAL OR DATAWAY PRESET)	FHC 1301	BF VERTRIEB	2	/71	(1)
C	24BIT BCD PRESET-SCALER (12MHZ, NIM OR TTL INPUTS,DATAWAY PRESET)	FHC 1302	BF VERTRIEB	1	/71	(1)
	PRESET SCALER (20MHZ,8DECADE BCD,7 SEGM LED INDICATES CONTENTS AND PRESET NO)	PSR 0801	GEC-ELLIOTT	1	/72	
	UP/DOWN PRESETTABLE COUNTER(24BIT,25MHZ, GATED,SEPARATE UP/DOWN COUNT INPUTS)	S2	JOERGER	1	/72	(5)
	PRESET SCALER(10MHZ,8 DECADE BCD,DISPLAY OF 2 SIGNIF NUMBERS+EXP,MAN PRESET,NIM)	C 103	RDT	3	/71	
	ECHELLE 6 DECADES A PRESELECTION(SCALER, MAN/DATAWAY PRESET,1MHZ,START/STOP O/P)	J EP 20	SAIP-CRC	2	/71	
C	REAL TIME CLOCK (3.8 USEC TO 18.2 HRS, PRESET-TIME AND PRESET-COUNT MODES)	RTC 2014	SEN	1	/71	

PARALLEL INPUT 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)
	INPUT REGISTER 24-BIT	3470	KINETIC SYSTEMS	1	/71	(4)
	PARALLEL INPUT REGISTER (16BIT,CONTINU-OUS OR STROBED MODES CONTROLLED BY REG)	7014-1	NUCL. ENTERPRISES	1	/70	
	STROBED INPUT REGISTER (12BIT COINC AND LATCH,NIM LEVELS,PATTERN AND L-REQ APPL)	SIR 2026	SEN	1	/70	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
C	DIGITAL INPUT 16 BIT POT. FREE	C 76451-A8-A2	SIEMENS	0		(6)
N	STATIC DIGITAL INPUT, TTL	C 76451-A8-A1	SIEMENS	0		(6)
	SINGLE 16 BIT PARALLEL INPUT REGISTER	PR-601	TECHCAL	1	/72	
	SINGLE 24 BIT PARALLEL INPUT REGISTER (BOTH WITH LED DISPLAY OPTION)	PR-603		1	/72	
C	INPUT REGISTER (24BIT, SPEC CONN, 8 BIT ALSO VIA LEMO,LAM ON NON-ZERO CR STROBE)	FHC 1308	BF VERTRIEB	1	/71	
N	DUAL INPUT REGISTER (2X16BIT WITH LAM AND STROBE FOR EACH CHANNEL)	PR 1610 SERIES	GEC-ELLIOTT	1	05/73	
N	32 BIT INPUT REGISTER	C 345	INFORMATEK	1	05/73	
N	DUAL INPUT REGISTER (2X16BIT)	301	POLON	1	09/73	
	DUAL INPUT DUAL OUTPUT REGISTER (16BIT, TTL IN, OPEN COLL TTL OUT, MAX 40MA,30V)	C110	RDT	1	/72	
	DUAL 16 BIT INPUT REGISTER (TTL LEVELS, CERN SPECS 072)	2IR 2002	SEN	1	/72	
	DUAL 16 BIT INPUT REGISTER(EXT STROBE OR DATAWAY COMMAND STORES DATA,TTL LEVELS)	2IR 2010	SEN	1	/70	
	DUAL 16 BIT INPUT REGISTER(CONTINUOUS, STROBED AND ONE-STROBE DATA ENTRY,TTL)	PR-602	TECHCAL	1	/71	
	DUAL 16 BIT PARALLEL INPUT REGISTER (WITH LED DISPLAY OPTION)	PR-604	TECHCAL	1	/72	
	DUAL 24 BIT INPUT REGISTER (TTL, HANDSHAKE)	RI-224	EG+G	1	/72	
N	DUAL INPUT REGISTER (2X24BIT WITH LAM AND STROBE FOR EACH CHANNEL)	PR 2400 SERIES	GEC-ELLIOTT	1	05/73	
C	INPUT/OUTPUT REGISTER (2X24BIT IN,2X6BIT OUT, HI-Z INPUT, LED DISPLAY)	IR	JOERGER	1	/72	
	DUAL PARALLEL INPUT REGISTER(2X24BIT,EXT LOAD REQUEST,4 OPER MODES,TTL LEVELS)	60	JORWAY	1	/70	
	24-BIT DUAL PARALLEL INPUT REGISTER	9041	NUCL. ENTERPRISES	1	/72	(5)
N	DUAL INPUT REGISTER (2X24BIT)	302	POLON	2	09/73	
N	PARALLEL INPUT REGISTER (2X24 BITS)	J RE 10	SAIP-CRC	1	04/73	
	UNIVERSAL INPUT/OUTPUT REGISTER (36BIT DATA+RANGE IN,12BIT REG O/P FOR CONTROL)	1031	BORER	1	/72	(3)
	INPUT READER (4X16BIT OR 64 BITS, TTL, 1=LOW, CONNECTORS OPTIONAL)	151	WALLAC	1		
	(SAME BIT WITH 4X24BIT OR 96 BITS)	152		1		
	(SAME BUT WITH 8X16BIT OR 128 BITS)	153		1		
	(SAME BUT WITH 8X24BIT OR 192 BITS)	154		1		
	(SAME BUT WITH 16X8BIT OR 128 BITS)	155		1		
	(SAME BUT WITH 16X16BIT OR 256 BITS)	156		1		
	24-BIT INTERRUPT REGISTER (STATUS COMPARED,CHANGE GIVES LAM)	1051	BORER	1	/72	(3)
	PRIORITY INPUT REGISTER(12BITS CRED TO LAM,FAST COINC LATCH APPL,NIM LEVELS)	63	JORWAY	2	/70	
	PRIORITY INTERRUPT REGISTER 16 BIT	3475	KINETIC SYSTEMS	1		
	INTERRUPT REQUEST REGISTER	EC 218	NUCL. ENTERPRISES	0		
	INTERRUPT REQUEST REGISTER (8BIT, TTL INPUTS TO REGISTER,ANY INPUT GIVES LAM.	7013-1	NUCL. ENTERPRISES	1	/70	
N	REQUIRE REGISTER	300	POLON	1		
N	COINCIDENCE LATCH (24 NIM INPUTS WITH COMMON STROBE, EXT RESET, 2NSEC OVERLAP)	C124	EG+G	2		
	COINCIDENCE BUFFER (2X12BIT,ONE STROBE PER 12BITS,MIN 2NS OVERLAP,NIM INPUTS)	C212	EG+G	2	/71	
N	DUAL 16 BIT FAST LATCH(FAST NIM/ECL I/P, STROBE FOR EACH CHANNEL, 6 NSEC OVERLAP)	PR 1605	GEC-ELLIOTT	1	05/73	
	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)
	16-CH COINCIDENCE REGISTER (16 CHANNELS, STROBE-INPUT OVERLAP 2NSEC,NIM LEVELS)	2341	LRS-LECROY	2	/71	(4)
	PATTERN UNIT (16 INDIV NIM INPUTS,COMMON NIM GATE)	021	NUCL. ENTERPRISES	2	/71	(5)
	PATTERN UNIT(16BIT,I/P STROBED WITH COMMON GATE,10 NSEC OVERLAP,NIM LEVELS)	C 101	RDT	2	/71	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	REGISTRE DE CONFIGURATION (16 BIT PATTERN UNIT, NIM I/P AND GATE)	J PU 10	SAIP-CRC	1	/72	
	PATTERN UNIT 16 BIT (16 INDIVIDUAL NIM INPUTS,COMMON NIM GATE, CERN SPECS 021)	16P 2007	SEN	2	/70	
C	16 BIT PATTERN UNIT (CERN SPECS 071, 16 INDIVIDUAL NIM INPUTS,COMMON NIM GATE)	16P 2047	SEN	1	/72	(6)

PARALLEL INPUT GATES (Dataway connecting)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	INPUT GATE 24-BIT	3420	KINETIC SYSTEMS	1	/71	(4)
	BALANCED INPUT REGISTER WITH ADDRESSING	3430	KINETIC SYSTEMS	1	/72	
	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	INPUT GATE	320	POLON	1	09/73	
N	DYNAMIC DIGITAL INPUT, TTL	C 76451-A17-A1	SIEMENS	0		(6)
N	DYNAMIC DIGITAL INPUT, POT. FREE	C 76451-A17-A2	SIEMENS	0		(6)
	SINGLE 16 BIT PARALLEL INPUT GATE	PG-601	TECHCAL	1	/72	
	SINGLE 24 BIT PARALLEL INPUT GATE (BOTH WITH LED DISPLAY OPTION)	PG-603		1	/72	
	DUAL PARALLEL STROBED INPUT GATE(2X24BIT HANDSHAKE MODE TRANSFER TO DATAWAY,TTL)	61	JORWAY	1	/70	
	DUAL PARALLEL INPUT GATE (2X24BIT,NON-INTERLOCK CONTROL TRANSF TO DATAWAY,TTL)	61-1	JORWAY	1	/70	
	INPUT GATE DUAL 24 BIT	3472	KINETIC SYSTEMS	1		
	DUAL 16 BIT PARALLEL INPUT GATE	PG-602	TECHCAL	1	/72	
	DUAL 24 BIT PARALLEL INPUT GATE (BOTH WITH LED DISPLAY OPTION)	PG-604		1	/72	(6)
	PARALLEL INPUT GATE (3X16BIT INPUT FROM ISOLATING CONTACTS)	1061	BORER	1	/72	(4)
N	PARALLEL INPUT GATE (3X16BIT INPUT FROM ISOLATING CONTACTS, DYNAMIC INPUTS)	1062	BORER	1		
	DIGITALES EINGANGSREGISTER(5X8BIT PARALL INPUT GATES,5TH BYTE SETS L,TTL,1=H)	DO 200-2001	DORNIER	1	/71	
	(WITH FRONT PANEL CONNECTOR)	DO 200-2201		1	/72	
	DIGITALES EINGANGSREGISTER(5X8BIT PARALL INPUT GATES,5TH BYTE SETS L,HLL,1=H)	DO 200-2002	DORNIER	1	/72	
	(WITH FRONT PANEL CONNECTOR)	DO 200-2202		1	/72	
	DIGITALES EINGANGSREGISTER MIT OPTOKOPP-LER(4X8BIT PARALLEL INPUT GATES,WITH L)	DO 200-2003	DORNIER	1	/72	
	(WITH FRONT PANEL CONNECTOR)	DO 200-2203		1	/72	
N	DIGITALES EINGANGSREGISTER, EXT STROBE (4X8BIT INPUT LATCHES, 1X8BIT SET LAM)	DO 200-2004	DORNIER	1	04/73	
N	(SAME WITH FRONT PANEL CONNECTOR)	DO 200-2204		1	04/73	
	PARALLEL INPUT GATE(16X16BIT,TTL, 1=LOW)	IG 25601	GEC-ELLIOTT	2	/72	
N	128 BIT RECEIVER (ADDRESSABLE AS 8 16BIT WORDS OR 128 1-BIT WORDS)	C 341	INFORMATEK	1	03/73	

MANUAL INPUT MODULES

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	WORD GENERATOR (24 BITS OF BINARY DATA, SWITCH SELECTED)	9020	NUCL. ENTERPRISES	1	/71	(2)
	PARAMETER UNIT 12 BIT (PROVIDES 12 BIT COMMUNICATION,PUSH BUTTON L-REQUEST)	P 2005	SEN	1	/70	
	16 BIT WORD GENERATOR	WGR-160	TECHCAL	1	/72	
	24 BIT WORD GENERATOR	WGR-240	TECHCAL	1	/72	
	WORD GENERATOR (24BIT WORD MANUALLY SET BY SWITCHES)	WG 2401	GEC-ELLIOTT	1	/71	
N	DATA SWITCHES (16/24 BITS,READABLE + CONTENT ADDR)	C 322	INFORMATEK	1	/72	
	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	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR

DATA STORAGE MODULES

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	CAMAC 16 WORD 24 BIT MEMORY	MC 5202	MICRO CONSULTANTS	2	/72	(6)
	16 WORD STORE	CS 0003	NUCL. ENTERPRISES	1		(4)
N	256 WORDS OF 24 BIT STORE MODULE	CS 0015	NUCL. ENTERPRISES	1	/72	
N	PROGRAMMABLE READ ONLY MEMORY	220	POLON	1		
N	MEMOIRE TAMPON (BUFFER MEMORY,256 13BIT WORDS, USABLE WITH J CAN 21 C/H)	J MT 20	SAIP-CRC	1	/72	

PARALLEL OUTPUT MODULES

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	12 BIT OUTPUT REGISTER(DC OR PULSE O/P, UPDATING STROBE OUTPUT,NIM LEVELS)	41	JORWAY	1	/71	(2)
	DIFFERENTIAL OUTPUT REGISTER	3030	KINETIC SYSTEMS	1	/72	
	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)
N	OUTPUT REGISTER (16BIT)	360	POLON	1	09/73	
	OUTPUT REGISTER (12BIT, NIM PULSES OR LEVELS OUT)	OR 2027	SEN	1	/70	
	DIGITAL OUTPUT 16 BIT POT 24V	C 76451-A9-A1	SIEMENS	0		(6)
	DIGITAL OUTPUT 16 BIT RELAYS	C 76451-A9-A2	SIEMENS	0		(6)
	SINGLE 16 BIT PARALLEL OUTPUT REGISTER (WITH LED DISPLAY OPTION)	PR-609	TECHCAL	1	/71	
	PARALLEL-OUTPUT REGISTER (24BIT, OPEN COLLECTOR OUTPUT, HANDSHAKE FACILITY)	MS PO 2 1230/1	AEG-TELEFUNKEN	1	/72	(4)
N	OUTPUT REGISTER (24BIT TTL VIA SPEC CONN 8BIT ALSO VIA FRONT PANEL LEMO)	FHC 1309	BF VERTRIEB	1	/72	
	24-BIT OUTPUT REGISTER	3071	KINETIC SYSTEMS	1	/72	
	PARALLEL OUTPUT REGISTER (24BIT TTL OUTPUT VIA 25-WAY CONNECTOR)	7054-3	NUCL. ENTERPRISES	1	/70	
N	OUTPUT REGISTER (24BIT)	351	POLON	1	09/73	
	SINGLE 24 BIT PARALLEL OUTPUT REGISTER (WITH LED DISPLAY OPTION)	PR-611	TECHCAL	1	/71	
	SINGLE 16 BIT PARALLEL OUTPUT REGISTER/DRIVER(WITH LED DISPLAY OPTION)	PR-609-A	TECHCAL	1	/71	
	SINGLE 24 BIT PARALLEL OUTPUT REGISTER/DRIVER(WITH LED DISPLAY OPTION)	PR-611-A	TECHCAL	41	/71	
	OUTPUT REGISTER (2X16BIT VIA ISOLATING CONTACTS)	1082	BORER	1	/72	(4)
N	OUTPUT REGISTER (2X16BIT)	352	POLON	1	09/73	
	DUAL INPUT DUAL OUTPUT REGISTER (16BIT, TTL IN, OPEN COLL TTL OUT, MAX 40MA,30V)	C110	RDT	1	/72	
	DUAL 16 BIT OUTPUT REGISTER (TTL LEVELS, OPEN COLL OUTPUTS VIA CABLE)	2OR 2008	SEN	1	/70	
	DUAL 16 BIT PARALLEL OUTPUT REGISTER (WITH LED DISPLAY OPTION)	PR-610	TECHCAL	1	/71	
	DUAL 16 BIT PARALLEL OUTPUT REGISTER/DRIVER(WITH LED DISPLAY OPTION)	PR-610-A	TECHCAL	1	/71	
	DUAL 24 BIT PARALLEL OUTPUT REGISTER/DRIVER(WITH LED DISPLAY OPTION)	PR-612-A	TECHCAL	41	/71	
	PARALLEL-OUTPUT-REGISTER (DUAL 24BIT, OR QUAD 12BIT,OPEN COLLECTOR OUTPUT)	MS PO 1 1230/1	AEG-TELEFUNKEN	1	/70	(1)
	OUTPUT REGISTER (2X24BIT DATA OUT,DATA-READY + BUSY FORM HANDSHAKE, TTL)	RO-224	EG+G	1	/72	
C	OUTPUT REGISTER (2X24BIT OR 6X8BIT, LED DISPLAY)	OR	JOERGER	1	/72	
	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	0		
	24-BIT DUAL OUTPUT REGISTER	9042	NUCL. ENTERPRISES	1	/72	(5)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	OUTPUT REGISTER (2X24BIT)	353	POLON	2	09/73	
N	PARALLEL OUTPUT REGISTER (2X24 BITS)	J RS 10	SAIP-CRC	1	04/73	
	DUAL 24 BIT PARALLEL OUTPUT REGISTER (WITH LED DISPLAY OPTION)	PR-612	TECHCAL	1	/71	(6)
	OUTPUT REGISTER/DRIVER (2X24BIT,OPTION ON POLARITY AND OPEN COLLECTOR OUTPUTS)	171	WALLAC	1		
	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	
	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	
N	128 BIT OUTPUT REGISTER (ADDRESSABLE AS 8 16BIT OR 128 1-BIT WORDS)	C 342	INFORMATEK	1	04/73	
	SWITCH (12BIT DATAWAY CONTROLLED RELAY REGISTER FOR SWITCHING AND MULTIPLEXING)	7066-1	NUCL. ENTERPRISES	1	/71	
C	OUTPUT DRIVER (2X16BIT, 40MA SINKING, WITH READ VIA DATAWAY, 1=LO)	OD 1613	GEC-ELLIOTT	1	/72	
C	(SAME, 1=HI)	OD 1614		1	/72	
C	OUTPUT DRIVER (2X16BIT, 125MA SINKING, WITH READ VIA DATAWAY, 1=LO)	OD 1617	GEC-ELLIOTT	1	/72	
C	(SAME, 1=HI)	OD 1618		1	/72	
C	OUTPUT DRIVER (2X16BIT, TOTEMPOLE FOR 30 TTL LOADS, WITH READ VIA DATAWAY)	OD 1620	GEC-ELLIOTT	1	/72	
	DRIVER (16BIT,OPEN COLLECTOR OUTPUT VIA MULTIWAY CONNECTOR,MAX 150MA/LINE)	9002	NUCL. ENTERPRISES	1	/71	
	DRIVER (24BIT OUTPUT REGISTER,SET AND READ BY COMMAND,24BIT I/P DATA ACCEPTED)	9013	NUCL. ENTERPRISES	1	/71	
C	OUTPUT DRIVER (2X24BIT, 40MA SINKING, WITH READ VIA DATAWAY, 1=LO)	OD 2403	GEC-ELLIOTT	1	/72	
C	(SAME, 1=HI)	OD 2404		1	/72	
C	OUTPUT DRIVER (2X24BIT, 125MA SINKING WITH READ VIA DATAWAY, 1=LO)	OD 2407	GEC-ELLIOTT	1	/72	
C	(SAME, 1=HI)	OD 2408		1	/72	
C	OUTPUT DRIVER (2X24BIT, TOTEMPOLE FOR 30 TTL LOADS, WITH READ VIA DATAWAY)	OD 2410	GEC-ELLIOTT	1	/72	
	DRIVER (24BIT OUTPUT REGISTER,SET AND READ BY COMMAND,24BIT I/P DATA ACCEPTED)	9017	NUCL. ENTERPRISES	1	/71	(1)
N	OUTPUT REGISTER (256X2JBIT, EX. ADDRESS)	110	HYTEC	1		
N	OUTPUT REGISTER (256X2JBIT, EX. ADDRESS)	109		1		
N	OUTPUT REGISTER (32X24BIT, EX. ADDRESS)	104		1		
N	OUTPUT REGISTER (32X24BIT, EX. ADDRESS)	100		1		
N	OUTPUT REGISTER (32X16BIT, EX. ADDRESS)	101		1		
N	OUTPUT REGISTER (16X24BIT, EX. ADDRESS)	105		1		

DISPLAY MODULES AND UNITS

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
C	24 BIT LED BCD DISPLAY (ONE FHC 1301/02/11 VIA SPEC CONNECTOR)	FHC 1305	BF VERTRIEB	1	/71	(1)
C	24 BIT NIXIE BCD DISPLAY (SELECTS ONE OF 10 FHC 1301/02/11 VIA SPEC CONNECTION)	FHC 1306	BF VERTRIEB	2	/71	(1)
N	24 BIT LED BINARY DISPLAY (ONE FHC 1313 OR FHC 1309 VIA SPECIAL CONNECTION)	FHC 1315	BF VERTRIEB	1	/72	
N	DISPLAY DRIVER (POINTPLOT CHAR GEN AND VECTOR GENERATOR)	DD 1601	GEC-ELLIOTT	2	06/73	
N	MEMORY OSCILLOSCOPE DISPLAY (VECTOR, CHARACTER AND HISTOGRAM GEN)	C 311	INFORMATEK	2	05/73	
	CRT DECIMAL DISPLAY SYSTEM (INCLUDING)	72A	JORWAY	NA	/71	(2)
C	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	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	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	
	INDICATOR (1X16BIT OR 2X8BIT,INDICATES STATE OF REGISTER LOADED FROM DATAWAY)	9014	NUCL. ENTERPRISES	1	/71	
	STORAGE OSCILLOSCOPE (DRIVER FOR TEKTRONIX 611 OR 601,USED WITH 7011)	9028	NUCL. ENTERPRISES	0	/71	(2)
	AFFICHAGE DECIMAL PAR L INTERMEDIAIRE D UN CALCULATEUR (DISPLAY OF 24BIT WORD)	J AF 15	SAIP-CRC	2	/71	
	AFFICHAGE BINAIRE MANUEL (CONTENT OF A REGISTER DISPLAYED,EXT MULTIWAY CONN)	J AF 20	SAIP-CRC	1	/71	
N	SCOPE DISPLAY DRIVER	J DD 10	SAIP-CRC	2	04/73	
N	MANUAL CONTROL OF J DD 10	MC 10		NA		
N	EXTERNAL DISPLAY FOR J EA 10 SCALER	C AE 10	SAIP-CRC	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	

PERIPHERAL INPUT/OUTPUT MODULES

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	DESK CALCULATOR CTRL (DIEHL INTERFACE TO FHC 1301/02/11 AND FHC 1309)	FHC 1312	BF VERTRIEB	1	/72	
C	TYPEWRITER DRIVE UNIT	TD 0801	GEC-ELLIOTT	2	06/73	(1)
N	TYPEWRITER DRIVER FOR OPTIMA 527	501	POLON	0	09/73	
C	TELETYPE O/P CTRL (10 FHC 1301/02/11 AND FHC 1309 VIA SPEC CONN,TTY MOTOR ON/OFF)	FHC 1307	BF VERTRIEB	1	/71	(1)
	TELETYPE INTERFACE	90	JORWAY	0	/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)
N	TELETYPEWRITER DRIVER	500	POLON	1	09/73	
N	TELETYPE DRIVER	J TY 10	SAIP-CRC	1	06/73	
C	TELETYPE INTERFACE	C-T-33	WENZEL ELEKTRONIK	1	/72	
C	PAPER TAPE PUNCH OUTPUT DRIVER (FOR FACIT 4070)	TP 0801	GEC-ELLIOTT	1	06/73	(1)
C	TAPE READER INTERFACE UNIT (FOR ELECTROGRAPHIC READER)	TR 0801	GEC-ELLIOTT	1	06/73	(1)
N	UNIVERSAL ASYNCHRONOUS TRANSMITTER/RECEIVER (129 CHAR.BUFFER)	C 317	INFORMATEK	1	03/73	
	B.S.INTERFACE READER (8BIT DATA + PARITY BIT,BRITISH STANDARD)	7057-1	NUCL. ENTERPRISES	1	/71	
	B.S.INTERFACE DRIVER (8BIT DATA + PARITY BIT,BRITISH STANDARD)	7058-1	NUCL. ENTERPRISES	1	/71	(1)
	PERIPHERAL READER(8BIT PARALLEL DATA IN, NEG OR POS TTL,HANDSHAKE CONTROLS)	7064-1	NUCL. ENTERPRISES	1	/71	(1)
	PERIPHERAL DRIVER (8BIT DATA OUT,NEG OR POS TTL,HANDSHAKE CONTROLS)	7065-1	NUCL. ENTERPRISES	1	/71	(1)
	UNIVERSAL INPUT/OUTPUT REGISTER (36BIT DATA+RANGE IN,12BIT REG O/P FOR CONTROL)	1031	BORER	1	/72	(3)
	STEP MOTOR DRIVER (MAX 32768 STEPS,RATE, ROTATION AND START/STOP FULLY COMMANDED)	1161	BORER	1	/72	(3)
	STEPPING MOTOR CONTROLLER, DUAL	3360	KINETIC SYSTEMS	1	/72	(4)
	STEPPING MOTOR DRIVER (USED WITH 7045)	0709	NUCL. ENTERPRISES	1	/71	
	DELAYED PULSE GENERATOR (4 TTL O/P,0.042 HZ-40KHZ RATE,LEVEL AND DIRECTION CONTR)	7045-1	NUCL. ENTERPRISES	1	/70	
N	COMMANDE DE MOTEUR PAS A PAS (STEPPING MOTOR DRIVER)	J CP 10	SAIP-CRC	1	01/73	
	DUAL INCREMENTAL POSITION ENCODER (2X20 BIT X-Y DIGITIZATION BY UP-DOWN COUNTER)	2IPE 2019	SEN	1	/71	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	STEPPER CONTROLLER	C-ST-C-5	WENZEL ELEKTRONIK	2	/72	
N	STEPPER CONTROLLER - INCREMENTAL MOTOR	C-ST-C-5I	WENZEL ELEKTRONIK	2	/72	
	MCA INTERFACE (I/O MODULE FOR MULTI-CHANNEL ANALYSER)		PACKARD	3		(4)
	INTERFACE CAMAC POUR CODEUR CA25/CA13/C97 (INTERFACING PULSE ADC TO CAMAC)	J CCA 10	SAIP-CRC	2	/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)
	FOUR FOLD BUSY DONE (START SIGNAL INITIATED BY COMMAND,DEVICE RETURNS LAM)	4BD 2021	SEN	1	/71	
N	FLOATING POINT ARITHMETIC INTERFACE (FOR USE WITH M 128 HARD. FLOAT. POINT)	C 327	INFORMATEK	1	01/73	
N	INTERFACE FOR CAMAC CONTROL OF PRECISION HIGH SPEED ADCS	MC 4059	MICRO CONSULTANTS	0		(6)
	WIRE DETECTOR SCANNER(64X16BIT MEMORY STORES 13BIT POSITION+3BIT CLUSTER DATA)	WCS-200	NANO SYSTEMS	1	/72	(5)
	SCANNER TEST MODULE	WCS-201		1	/72	(5)
	PROPORTIONAL CHAMBER READ-OUT (USED WITH SPEC CONTROLLER TYPE COFIL OR ALONE)	REFIL	SAIP-CRC	2	/71	
	SEQUENTIAL OUTPUT REGISTER (SERIAL-CODED NIM PULSES OUT,LOGIC 0=40NSEC,1=150NSEC)	SOR	SAIP-CRC	1	/71	
	SEQUENTIAL INPUT REGISTER(16 8BIT BYTES, STORES CODED NIM PULSES,0=40,1=150NSEC)	SIRE	SAIP-CRC	1	/71	
C	SPARK CHAMBER READ OUT (POSITION AND ADDRESS CODING OF MULTIPLE SPARK SITES)	J SC 10/SCRC-041	SAIP-CRC	2	/70	(6)
	SPARK CHAMBER READ OUT TERMINAL	SCRC TML-043		5	/70	
C	PLUMBICON READ OUT (5 SCALERS RECORD DIGITIZED OUTPUTS FROM PLUMBICON CAMERA)	J PM 10/PLUM	SAIP-CRC	1	/71	(6)
C	PLUMBICON READ OUT TERMINAL	J PG 10/PUDDING		1	/71	(6)
N	INTERACTIVE GRAPHICS (SEE OTHER SYSTEM UNITS, WDV)		WDV			

MULTIPLEXERS

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	15 CHANNEL MULTIPLEXER (ANALOGUE SIGNALS ROUTED TO ADC/DVM,DIRECT + SCAN MODES)	1701	BORER	1	/72	(3)
	16-CHANNEL FAST MULTIPLEXER (FET SWITCHES FOR ADC 1242 AND 1243)	1704	BORER	1	/72	(4)
	SEE ALSO DORNIER ADC TYPES		DORNIER			
C	ELEKTRONISCHER MULTIPLEXER (16 CHANNELS, MAX +OR-10V,DATAWAY SET+INCR ADDRESS)	DO 200-1031	DORNIER	1	/72	
C	(WITH FRONT PANEL CONNECTOR)	DO 200-1231		1	/72	
C	ELEKTRONISCHER MULTIPLEXER (8 DIFF I/P, MAX +OR-10V, DATAWAY SET+INCR ADDRESS)	DO 200-1033	DORNIER	1	/72	
C	(WITH FRONT PANEL CONNECTOR)	DO 200-1233		1	/72	
C	ELEKTRONISCHER MULTIPLEXER(16 DIFF I/P, MAX +OR-10V, DATAWAY SET+INCR ADDRESS)	DO 200-1034	DORNIER	1	/72	
C	(WITH FRONT PANEL CONNECTOR)	DO 200-1234		1	/72	
	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	
C	ANALOG MULTIPLEXER (15 CHANNELS,REED RELAYS,MAN AND DATAWAY SEL, EXPANDABLE)	AM	JOERGER	2	/72	(6)
N	FET ANALOG MULTIPLEXER (15 CHANNELS, MANUAL AND DATAWAY SELECT, EXPANDABLE)	AM/FET	JOERGER	1	02/73	
	MULTIPLEXER-SOLID STATE (16 SINGLE-ENDED OR 8 DIFF CHAN,RANDOM OR SEQUENT ACCESS)	9026	NUCL. ENTERPRISES	1	/71	
N	MULTIPLEXEUR A RELAIS (16 CHANNELS, STANDARD LEVEL)	J MX 10	SAIP-CRC	1	04/73	
N	(SAME FOR LOW LEVEL)	J MX 20		1	04/73	
N	MULTIPLEXER MANUAL CONTROL	J AX 10		1	04/73	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
C	12 INPUT ANALOGUE MULTIPLEXER (RANDOM OR SCAN ACCESS CONTROLLED BY SKIP REGISTER)	MX 2025	SEN	1	/72	(6)
	32-CHANNEL FAST MULTIPLEXER (FET SWITCHES FOR ADC 1242 AND 1243)	1703	BORER	1	/72	(4)
C	ELEKTRONISCHER MULTIPLEXER (32 CHANNELS, MAX +OR-10V, DATAWAY SET+INCR ADDRESS)	DO 0200-1032	DORNIER	1	/72	
C	(WITH FRONT PANEL CONNECTOR)	DO 200-1232		1	/72	
N	ELEKTRONISCHER MULTIPLEXER (32 DIFF I/P, MAX +OR-10V, DATAWAY SET+INCR ADDRESS)	DO 200-1037	DORNIER	2	/72	
N	(SAME WITH FRONT PANEL CONNECTORS)	DO 200-1237		2	/72	
	MULTIPLEXER (32 CHANNEL, 2 CONTACTS)	C 76451-A4-A1	SIEMENS	2		
	MULTIPLEXER (32 CHANNEL, 4 CONTACTS)	C 76451-A4-A2	SIEMENS	2		
N	SENSOR (INTER. UP TO 65.000 GROUPS OF 16/32 BITS, READS PATTERNS OR ADDRESSES)	C 347	INFORMATEK	1	04/73	

CODE CONVERTERS

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	BINARY TO-BCD-CONVERTER (24BIT BIN,8 DECIMAL DIGIT OUTPUT VIA TWO CONNECTORS)	7068-1	NUCL. ENTERPRISES	1	/70	(2)
N	BINARY TO DECIMAL CODE CONVERTER	610	POLON	1	10/73	
C	BINARY TO BCD-CONVERTER(24BIT TO 8 DECADE,DISPLAY,CONV 4USEC,TTL LEVEL OUT,1=H)	C-BBC-24	WENZEL ELEKTRONIK	2	/71	

ANALOGUE-TO-DIGITAL CONVERTERS (ADC, DVM)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
C	ANALOGE EINGAENGE(MULTIPLEXER-ADC,8 I/P TO ONE ADC,+/-10V RANGE,7BITS/10V+SIGN)	DO 200-1011	DORNIER	2	/72	
	(SAME WITH 8 DIFFERENTIAL INPUTS)	DO 200-1013		2	/72	
C	ANALOGE EINGAENGE(MULTIPLEXER-ADC,8 I/P TO ONE ADC,+/-5V RANGE,7BITS/ 5V+SIGN)	DO 200-1014	DORNIER	2	/72	
	(SAME WITH 8 DIFFERENTIAL INPUTS)	DO 200-1016		2	/72	
	ANALOGE EINGAENGE(MULTIPLEXER-ADC,8 I/P TO ONE ADC, +10V RANGE,8BITS/10V)	DO 200-1017	DORNIER	2	/72	
	(SAME WITH 8 DIFFERENTIAL INPUTS)	DO 200-1019		2	/72	
C	ANALOGER EINGANG (ADC, +/-10V RANGE, 7BITS/10V+SIGN)	DO 200-1027	DORNIER	2	/72	
C	(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	ANALOGUE TO DIGITAL INTEGR. CONVERTER	700	POLON	1	09/73	
N	CONVERTISSEUR TENSION-FREQUENCE (ADC USED WITH MULTIPLEXERS J MX 10/20)	J CTF 10	SAIP-CRC	2	04/73	
N	UP-DOWN SCALER/FREQUENCY METER	J EF 10		1	04/73	
	SINGLE 8 BIT A/D CONVERTER	S-AD-008	TECHCAL	1	/72	(6)
	DUAL 8 BIT A/D CONVERTER	D-AD-008	TECHCAL	1	/72	(6)
N	DUAL DIGITAL VOLTMETER (+AND- 0.1V, 10 BIT, DIFFERENTIAL INPUT)	2DVM 2013	SEN	1	/71	
	DIGITALVOLTMETER (RANGES: DC0.02 TO 20V, 5 MA TO 100 MA,AC 0.01 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		
	SINGLE 10 BIT A/D CONVERTER	S-AD-010	TECHCAL	1	/72	(6)
	DUAL 10 BIT A/D CONVERTER	D-AD-010	TECHCAL	1	/72	(6)
	DUAL SLOPE ADC (+AND- 0.01/1/10V RANGES, 11BIT RESOLUTION,20MS CONV TIME)	1241	BORER	2	/72	(3)
	SUCCESS. APPROX. ADC (11BIT+SIGN, +AND-10V DIFF IN, 20 USEC CONVERSION)	1242	BORER	2	/72	(4)
	SUCCESS. APPROX. ADC (AS 1242 BUT WITH SAMPLE AND HOLD)	1243	BORER	2	/72	
C	ANALOGE EINGAENGE (MULTIPLEXER-ADC,8 I/P TO ONE ADC,+/-10V RANGE,11BITS/10V+SIGN)	DO 200-1001	DORNIER	2	/72	
	(SAME WITH 8 DIFFERENTIAL INPUTS)	DO 200-1003		2	/72	
C	ANALOGE EINGAENGE(MULTIPLEXER-ADC,8 I/P TO ONE ADC,+/-5V RANGE,11BITS/ 5V+SIGN)	DO 200-1004	DORNIER	2	/72	
	(SAME WITH 8 DIFFERENTIAL INPUTS)	DO 200-1006		2	/72	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	ANALOGE EINGAENGE(MULTIPLEXER-ADC,8 I/P TO ONE ADC, +10V RANGE, 12BITS/10V)	DO 200-1007	DORNIER	2	/72	
	(SAME WITH 8 DIFFERENTIAL INPUTS)	DO 200-1009		2	/72	
C	ANALOGER EINGANG (ADC, +/-10V RANGE, 11BITS/10V+SIGN)	DO 200-1024	DORNIER	2	/72	
C	(SAME FOR +/-5V RANGE,11BITS/ 5V+SIGN)	DO 200-1025		2	/72	
	(SAME FOR +10V RANGE,12BITS/10V)	DO 200-1026		2	/72	
	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)
	A/D CONVERTER (12BIT,MAX 20 USEC CONVERSION, +AND-5V, +AND-10V, +10V RANGES)	30	JORWAY	2	/71	(2)
	CAMAC ADC/DAC UNIT (PC CARD FOR SAMPLE-HOLD 12BIT ADC AND DAC CIRCUITS)	MC 5200	MICRO CONSULTANTS	1	/72	(6)
	ANALOGUE TO DIGITAL CONVERTER (12BIT, 20 MSEC CONVERSION,RANGE -5V TO +5V)	7055-1	NUCL. ENTERPRISES	1	/70	
	SINGLE 12 BIT A/D CONVERTER	S-AD-012	TECHCAL	1	/72	(6)
	DUAL 12 BIT A/D CONVERTER	D-AD-012	TECHCAL	1	/72	(6)
C	ANALOGER EINGANG(DUAL SLOPE ADC, +/-10V RANGE,14BITS/10V+SIGN,0.2SEC CONVERSION)	DO 200-1021	DORNIER	1	/72	
	MULTI-MODE LINEAR ADC (8BIT,40MHZ CLOCK, AREA AND PEAK MODES,NIM LEVELS)	2243A	LRS-LECROY	1	/70	(2)
	OCTAL ADC (8 FAST I/P,8BIT/CH, 150USEC CONVERSION,COMMON GATE,NIM LEVELS)	2248	LRS-LECROY	1	/71	
	OCTAL ADC (MIN 5 NSEC PULSES, POS OR NEG 8BIT/100 PC RESOLUTION, 250 USEC CONV)	9040	NUCL. ENTERPRISES	1	/72	(4)
	CONVERTISSEUR ANALOGIQUE NUMERIQUE A 512 CANAUX(PULSE ADC,10MHZ CLOCK,0.1/10V)	J CAN 31	SAIP-CRC	3	/71	
	CONVERTISSEUR ANALOGIQUE NUMERIQUE RAPIDE A 8000 CANAUX(PULSE ADC,100MHZ CLOCK)	JCAN20C/JCAN20H	SAIP-CRC	6	/71	
	INTERFACE POUR CODEUR J CAN 20 ET BLOC MEMOIRE BM 96 (ADC-MEMORY INTERFACE)	J CAN 20 I		2	/71	
N	CONVERTISSEUR ANALOGIQUE NUMERIQUE (16.000 CHANNEL PULSE ADC, 200MHZ CLOCK)	J CAN 21 C/H	SAIP-CRC	6	/72	(6)
N	CONVERTISSEUR ANALOGIQUE DIGITAL (1024 CHANNEL PULSE ADC, 100MHZ CLOCK)	J CAN 40	SAIP-CRC	2	/72	(6)

DIGITAL-TO-ANALOGUE CONVERTERS (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	OCTAL DAC (8 CHANNELS,10BIT 5V 500HMS OR 2 S CMPL 9BIT+SIGN, +AND- 5V, 10 USEC)	DAC 1081	GEC-ELLIOTT	1	04/73	
	D/A CONVERTER (12BIT,5 USEC CONVERSION, O/P RANGES +AND-2.5V/5V/10V AND +5V/10V)	31	JORWAY	1	/71	(2)
	CAMAC ADC/DAC UNIT (PC CARD FOR SAMPLE-HOLD 12BIT ADC AND DAC CIRCUITS)	MC 5200	MICRO CONSULTANTS	1	/72	(6)
N	DIGITAL TO ANALOGUE CONVERTER	7015	NUCL. ENTERPRISES	1	/70	
N	DIGITAL TO ANALOGUE CONVERTER	720	POLON	1	09/73	
N	DIGITAL TO ANALOGUE CONVERTER	721	POLON	2	09/73	
	DUAL DIGITAL-TO-ANALOG CONVERTER (10BIT, OUTPUT 0 TO +10V OR -5 TO +5V)	2DAC 2011	SEN	1	/71	
N	DUAL-DIGITAL-ANALOG-CONVERTER (10 BIT, MAX +AND- 10V OR +AND- 20 MA)	C 76451-A15-A2	SIEMENS	1		(6)
N	(SAME WITH 12 BIT)	C 76451-A15-A3	SIEMENS	1		(6)
N	(SAME WITH 16 BIT)	C 76451-A15-	SIEMENS	1		
	SLAVE BOARD DUAL D/A CONVERTER	DA-2001	TECHCAL	1	/71	
	DUAL DIGITAL TO ANALOG CONVERTER (10BIT RESOLUTION,10MSEC CONV TIME,O/P 5V MAX)	DA-2000	TECHCAL	1	/71	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR

TIME-TO-DIGITAL CONVERTERS

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	QUAD CAMAC SCALER (4X16BIT CR 2X32BIT, 40MHZ)	1004	BORER	1	/72	
C	TIME DIGITIZER (4X16BIT,50MHZ CLOCK,WITH CENTRE FINDER, USABLE WITH PRE-AMP 511)	1005	BORER	1	/72	
N	TIME DIGITIZER (4 NIM STOP CHANNELS, COMMON START, 200 PSECS RESOLUTION)	TD104	EG+G	1		
	QUAD 16-BIT SPARK READ-OUT REGISTER (20MHZ RATE,TTL LEVELS)	SR 1604	GEC-ELLIOTT	1	/71	
	QUAD TIME-TO-DIGITAL CONVERTER(9BIT/CH, 102/510NSEC RANGES,13USEC CONVERS,NIM)	2226A	LRS-LECROY	1	/70	(2)
C	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)
N	SERIAL TIME DIGITIZER (8X8BIT 100MHZ, SER + SEQUENT COUNT MODE,SHIFT-REG GATE)	STC 2050	SEN	1	/72	

OTHER ANALOGUE AND/OR DIGITAL MODULES

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	
N	PROGRAMMIERBARER VERSTAERKER/ABSCHW (ATTENUATION -60DB TO 0DB, 6 STEPS, AMPLIFICATION 0DB TO 60DB, 6 STEPS)	DO 200-1052	DORNIER	2	04/73	
	FAN-OUT UNIT (2 ORED INPUTS PROVIDE 8 TRUE,2 COMPLEM OUTPUTS,NIM SIGNALS)	FO 0801	GEC-ELLIOTT	1	/71	
	POWER SUPPLY CONTROLLER 10-BIT	3155	KINETIC SYSTEMS	1	/71	(4)
	POWER SUPPLY CONTROLLER 12-BIT	3156	KINETIC SYSTEMS	1	/72	
	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	
N	DIFFERENTIAL AMPLIFIER (GAIN CONTROLLED FROM DATAWAY)	CS 0014	NUCL. ENTERPRISES	2	/72	
N	TENSION D ETALONAGE (VOLTAGE CALIBRATOR)	J ET 10	SAIP-CRC	1	04/73	
	SIX-FOLD CONTROLLED GATE (INDIV GATING, FAN-IN AND FAN-OUT CONTROLLED BY 3 REGS)	6CG 2017	SEN	1	/71	(4)
C	STROMGENERATOR (CURRENT SOURCE)	C 76451-A5-A1	SIEMENS	2		

PULSE GENERATORS AND CLOCKS

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
C	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 DECADES-1HZ TO 1MHZ-500NS PULSES OUT,TTL)	PG 0001	GEC-ELLIOTT	1	/71	
N	REAL TIME CLOCK (4SEC CLOCK/5MSEC STOP WATCH)	C 320	INFORMATEK	1	/72	
N	CLOCK GENERATOR (INT 10MHZ, EXT 50MHZ, 8 DECADE STEPS,PLUS PROGRAMMABLE OUTPUT)	CG	JOERGER	1	/72	
N	REAL TIME CLOCK (COUNTS .1 SEC TO 999 DAYS, DISPLAYS HRS/MIN/SEC, 50/60HZ GEN)	RTC	JOERGER	2	01/73	
	CLOCK PULSE GENERATOR (7 OUTPUTS-1HZ TO 1MHZ-IN DECADE STEPS,10MHZ EXT IN,TTL)	7019-1	NUCL. ENTERPRISES	1	/70	
N	CLOCK PULSE GENERATOR	730	POLON	1	10/73	
N	ASTRONOMICAL TIME CLOCK	731	POLON	1	11/73	
N	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	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	HORLOGE A QUARTZ 1 MHZ(CLOCK,7 C/P-1HZ TO 1MHZ-200 TO 800 NSEC WIDTH,TTL LEVEL)	J HQ 10	SAIP-CRC	1	/71	
C	REAL TIME CLOCK (3.8 USEC TC 18.2 HRS, PRESET-TIME AND PRESET-COUNT MCDES)	RTC 2014	SEN	1	/71	
C	CLOCK/TIMER	C 76451-A14-A1	SIEMENS	1	/72	
N	TIMER	C 76451-A12-A1	SIEMENS	0		(6)
	CAMAC-CLOCK-GENERATOR(7 DECADES-10MHZ TC 1HZ,50/500 NSEC O/P PULSES,2.8V/50 OHMS)	C-CG-10	WENZEL ELEKTRCNIK	1	/71	
	TEST PULSE GENERATOR (5 TO 50 NSEC NIM O/P PULSE DERIVED FROM S1.F(25) OR EXT)	TPG 0202	GEC-ELLICTT	1	/71	
	DUAL PROGRAMMED PULSE GENERATOR(50HZ/ 2KHZ/5MHZ PULSE TRAIN,LENGTH BY COMMAND)	2PPG 2016	SEN	1	/71	
C	TIME BASE (10 TO 100MHZ IN INCREMENTS CF 10MHZ, USED WITH TD 2031/TD 2041)	TB 2032	SEN	1	/71	
	MULTIPULSER (0.5-300 MHZ BURSTS,NIM SIGNAL,TTL TRIGGER,NIM OUT,600PSEC RISE)	C 72454-A1450-A1	SIEMENS	2	/72	

LOGIC FUNCTION MODULES

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	SIX-FOLD CONTROLLED GATE (INDIV GATING, FAN-IN AND FAN-OUT CONTROLLED BY 3 REGS)	6CG 2017	SEN	1	/71	(4)

DELAY AND ATTENUATOR UNITS

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	DUAL ATTENUATOR(50 OHMS,DATAWAY CONTROL-LED,RANGE 0DB TO 31DB IN 1DB STEPS)	9004	NUCL. ENTERPRISES	1	/71	
	ATTENUATEUR PROGRAMMABLE(MAN AND DATAWAY CONTROL OF ATTENUATION,0 DB TO 60 DB)	J AT 10	SAIP-CRC	3	/70	

CRATES- NO POWER, NO DATAWAY

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	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)
	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)		PCLON	25	/71	
	CAMAC SYSTEM BIN (WITH MODULAR SUPPLY)		RO ASSCCIATES	25	/70	
	CRATE, EMPTY	C 76455-A3	SIEMENS	25	/72	
	CAMAC CRATE (EMPTY CRATE)	C	STNC ENGINEERING	25		
	CAMAC CRATE (EMPTY CRATE)	CS		25		
	CAMAC CRATE (EMPTY)	WC	TECHCAL	25	/71	
	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 CNE 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		
	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	
N	CRATE (6U EMPTY,WITH VENTILATION BAFFLE)	IB/9905-5HV1	OSL/IMHCF-BEDCO	25	01/73	
N	FAN MOUNTING PLATE (FOR IB/9905-5HV1)	CAM/FM			01/73	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	CAMAC COMPATIBLE CRATE	NSI 875 DB/WV	NUCL. SPECIALTIES	25	/70	
	CAMAC CRATE	NSI 875 CC 100	NUCL. SPECIALTIES	25		(5)
	VENTILATED CRATE NO POWER NO DATAWAY (TWO FANS)	CCHN	RDT	25	/71	
	(SAME WITH 3 FANS)	CCHNA		25	/72	
	CAMAC CRATE (5U NON-VENTILATED,380 MM DEEP)	5UCAM	WILLSHER + QUICK	25	/71	(2)
	(6U VENTILATED,NO FAN,380 MM DEEP)	6UCAM		25		(2)
	(6U VENTILATED RECESSED,NO FAN,430 MM)	6URCAM		25		(2)
	CAMAC HEAVY DUTY CRATE (WITH DEPTH OPTIONS: *=S FOR 380MM, *=E FOR 525MM, *=TP FOR 525MM 2-PIECE VERSION)		WILLSHER + QUICK			
	5U NON VENTILATED	HD5U CAM(*)		25	/72	(5)
	6U VENTILATED(**=G FOR ADDITIONAL GRILL)	HD6U CAM(*)**		25	/72	(5)
	7U VENTILATED(**=G FOR ADDITIONAL GRILL)	HD7U CAM(*)**		25	/72	(5)

CRATES- WITH DATAWAY, NO POWER

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	CAMAC-RAHMEN MIT DATENWEG	1250-0001	DUCKERT	25	/72	
C	VENTILATED CRATE (STANDARD 24 STATION FASTON CONNECTORS)	VC 0010	GEC-ELLIOTT	24	/70	
C	VENTILATED CRATE (STANDARD 25 STATION FASTON CONNECTORS)	VC 0011	GEC-ELLIOTT	25	/72	
N	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	7005-2	NUCL. ENTERPRISES	24	/70	
N	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	
	CRATE (WIRED CRATE)	WCS	STND ENGINEERING	25		(5)

CRATES- WITH DATAWAY AND POWER

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
C	CRATE (270VA,COOLED,MODULAR POWERED BY UP TO 8 REGULATORS 1922 OR 1925+1922)	1902A	BORER	25	/69	
C	VOLTAGE REGULATOR (FOR +OR-24V/6A, +/-12V/7A,+/-6V/8A/16A24A)	1922			/69	
C	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	
N	CONVERTS FASTON CONNECTORS TO RECOMMENDED FIXED POWER CONNECTOR ON CHOSEN CRATE	/AMP	GEC-ELLIOTT		01/73	
N	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)
	CRATE WITH F.P.C. DATAWAY AND POWER RAIL ASSEMBLY	TYPES 1,2,5,6	MB METALS	25	/72	
	POWER CRATE (7005-2 CRATE WITH 9022 POWER SUPPLY)	9023	NUCL. ENTERPRISES	24	/71	(2)
	CHASSIS ET TIROIRS AVEC ALIMENTATION (POWERED CRATE)		POLON	25	/71	
N	CAMAC POWER SUPPLY (+AND- 6V/25A, +AND- 24V/6A)	AEC-432	POWER DESIGNS	25	/72	
	POWERED CRATE	CCHN-CSAN	RDT	25	/71	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
C	CHASSIS ALIMENTATION (POWERED CRATE, VENTILATED,+6V/25A,-6V/15A,+AND-24V/3A)	C JAL 40	SAIP-CRC	25	/71	
	POWERED CRATE(SEE P4 ALJ 13)	C4 ALJ 13 D	SAPHYMO-SRAT	25	/71	(1)
	POWERED CRATE(SEE P6 ALJ 13)	C6 ALJ 13 D		25		(1)
	POWERED CRATE(SEE P7 ALJ 13)	C7 ALJ 13 DW		25		(1)
	POWER SUPPLY (CAMAC CRATE)	CM5125/53/DW/BIP	SAPHYMO-SRAT	25	/72	
	POWER SUPPLY (CAMAC CRATE)	CM5125/53/AW/BIP		25		
	POWER CRATE (200W MAX,+6V/25A,-6V/10A, +AND-12V/3A,+AND-24V/3A,200V/0.05A)	PC 2006/B	SEN	25	/70	
	POWER CRATE (200W MAX,+6V/25A,-6V/10A, +AND-24V/3A,200V/0.05A)	PC 2006/C		25	/71	
	POWERED CRATE (7U,VENT,+AND-6V/26A,+AND-12V/6.5A,+AND-24V/6.5A,200V/0.1A,200W)	C 76455-A2	SIEMENS	25	/71	(3)
	POWERED CRATE (SAME BUT WITH 117V AC)	C 76455-A1		25	/71	
	POWERED CRATE (+AND-6V/25A, +AND-24V/6A, OPTIONAL +AND-12V/3A,+AND-200V/0.1A)	PCS	STND ENGINEERING	25		(5)
	POWERED CRATE SYSTEM	1410-PPC	TECHCAL	25	/71	

POWER SUPPLIES AND SUPPLY CONTROLS

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
C	COMPACT POWER SUPPLY UNIT (CRATE/PANEL MOUNT,+AND-6V/25A,+AND-24V/6A,200/300W)	PS C003	GEC-ELLIOTT		/71	
N	CAMAC POWER UNIT (+6V/15A,-6V/3A,+24V/2A -24V/2A,200V/0.05A,117VAC)	CPU/4	GRENSON			
	CAMAC POWER SUPPLY (+6V/20A,-6V/5A,+AND-24V/5A,200V/0.05A)	CPU/2	GRENSON		/71	
	SAME WITH SWITCHED METERING	CPU/2M			/71	
	POWER SUPPLY (+6V/20A,-6V/5A, +AND-12V/2A,+AND-24V/3A)	CPU/5	GRENSON		/71	
	POWER SUPPLY (RACK MOUNTING,+6V/25A, -6V/15A,+AND-24V/5A,200V/0.1A)	CPU/6	GRENSON		/71	
	POWER SUPPLY (RACK MOUNTING,+6V/25A, -6V/15A,+AND-24V/5A,+AND-12V)	CPU/7	GRENSON		/71	
	CRATE WITH F.P.C. POWER RAIL ASSEMBLY	TYPES 3,4,7,8	MB METALS		/72	
	POWER SUPPLY (+6V/20A,-6V/5A, +AND-24V/5A,200V/0.05A)	9001	NUCL. ENTERPRISES		/71	
	POWER UNIT (+6V/15A,-6V/3A, +AND-24V/2A,200V/0.05A)	9022	NUCL. ENTERPRISES		/71	(2)
N	POWER SUPPLY (+6V/15A,-6V/4A,+AND-24V/2A +200V/0.05A NONSTABILISED, MAX 300W)	CZC-10	POLON		06/73	
N	POWER UNIT (+6V/20A, -6V/15A,+24V/2A, -24V/2A,200V/0.1A)	SP 426	POWER ELECTRONICS			
	POWER SUPPLY (+6V/25A,-6V/5A, +AND-12V/2A,+AND-24V/3A,200V/0.1A)	C 303	RDT		/71	
	POWER 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)
	CAMAC POWER SUPPLY(+AND-6V/25A MAX 150W, +AND-24V/6A MAX 150W,12V AND 200V CPT)	1410	TECHCAL		/71	
	POWER SUPPLY FLEXIBLE SYSTEM COMPRISING	CPU/1	GRENSON		/71	
	BASIC CRATE(FOR SUPPLY MODULES,INCLUDES REFERENCE,CONTROL AND 200V/0.1A)	CFC				
	SUPPLY MODULE (+6V/6A)	CFP/6				
	(-6V/6A)	CFM/6				
	(+12V/3A)	CFP/12				
	(-12V/3A)	CFM/12				
	(+24V/3A)	CFP/24				
	(-24V/3A)	CFM/24)				
	POWER UNIT(FOR SUPPLY MODULES)		RO ASSOCIATES		/71	
	CAMAC SYSTEM POWER SUPPLY MODULE (+AND-12V/72W, OR +12V/6A OR +24V/3A)	C 301			/70	
	(6V/10A)	C 210			/70	
	(6V/5A AND 24V/1A)	C 211			/70	
	(6V/5A, +12V/0.4A, -12V/0.4A)	C 213			/70	
	(12V/4A)	C 250			/71	
	(24V/2A)	C 251			/71	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	POWER SUPPLY SYSTEM (CRATE) (MODULE OPTIONS AS FOLLOWS)	C4 BIP 203	SAPHYMC-SRAT		/72	
	POWER SUPPLY MODULE 6 V 10 A	BIP B6 10				
	6 V 15 A	BIP C6 15				
	6 V 20 A	BIP D6 20				
	6 V 40 A	BIP E6 40				
	12 V 7 A	BIP B12 7				
	12 V 10 A	BIP C12 10				
	12 V 15 A	BIP D12 15				
	12 V 25 A	BIP E12 25				
	24 V 3.5A	BIP B24 35				
	24 V 6 A	BIP C24 6				
	24 V 9 A	BIP D24 9				
	24 V 15 A	BIP E24 15				
C	SUPPLY CHASSIS 2KW (RAW SUPPLY FOR REGULATOR MODULES)	ALB/10	SAPHYMC-SRAT		12/73	(2)
	FAN UNIT	VALB/10				
	WIRED RACK 42 U	BC 42				
	POWER SUPPLY MODULE 6 V 5 A(REGULATOR)	BPR 605				
	6 V 10 A	BPR 610				
	6 V 25 A	BPR 625				
	12 V 2 A	BPR 122				
	12 V 5 A	BPR 125				
	24 V 3 A	BPR 243				
	24 V 5 A	BPR 245				
N	VOLTAGE MONITOR PANEL USING LEDS	MP 2	GEC-ELLIOTT	1	/72	
	MAINS SWITCH ASSEMBLY	MS 3	GEC-ELLIOTT	NA	/71	
	POWER SUPPLY MONITOR PANEL (WITH MAINS SWITCH, TEST POINTS AND LED INDICATION)	PSMP 1	GEC-ELLIOTT	NA	/72	
	POWER 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	

VENTILATION EQUIPMENT

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
C	1U COOLING DRAWER (FOR CRATE ONLY, 2 FANS, FITS 6U CRATE)	CDR 1	GEC-ELLIOTT		/72	
C	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	SAPHYMC-SRAT		/72	
	CRATE BLOWER UNIT		STNC ENGINEERING			(5)
	VENTILATION UNIT	1UVCAM	WILLSHER + QUICK		/71	(3)
	1U VENTILATION GRILL	1 UG	WILLSHER + QUICK		/72	
	2U VENTILATION GRILL	2 UG			/72	

EXTENDERS AND ADAPTERS

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	EXTENSION FRAME (MODULE EXTENDER)	EF 1-1	GEC-ELLIOTT	1	/71	
C	MODULE EXTENDER (+AND-6V,+AND-24V FUSED, RETRACTABLE LOCKING DEVICE)	ME	JOERGER	1	/72	
	EXTENDER MODULE	11	JORWAY	1	/71	
	EXTENDER CARD	1000	KINETIC SYSTEMS	1	/71	(4)
	EXTENSION UNIT	7007-1	NUCL. ENTERPRISES	1	/70	
N	EXTENDER		POLON	1	04/73	
	EXTENDER	CEX	RDT	1	/72	
N	NIM/CAMAC ADAPTOR	ANC 10	SAIP-CRC		/72	
	MODULE EXTENDER	ME 2030	SEN	1	/70	
C	EXTENDER (XXX=LENGTH OF CABLE IN MM BEYOND RACK)	CAMEX/XXX	TEKDATA	1	/72	(5)
	PROLONGATEUR POUR TIROIRS CAMAC (EXTENDER)		TRANSRACK	1	/70	
	NIM ADAPTOR	7009-2	NUCL. ENTERPRISES	NA	/70	
	CAMAC NIM ADAPTOR	CNA 2033	SEN	2	/71	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	NIM-CAMAC ADAPTOR	CAN	RCT	NA	/71	

MODULE PARTS

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	BLANK MODULE KIT (SINGLE WIDTH)	BM 1	GEC-ELLIOTT	1	01/73	
N	(DOUBLE WIDTH)	BM 2		2		
N	NEW SIMPLIFIED (TRIPLE WIDTH)	BM 3		3		
N	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-KASSETTE (EMPTY MODULE,WIDTH 1/25)	2.090.001.8	KNUERR	1	/70	(2)
	(WIDTH 2/25)	2.090.002.8		2		
	(WIDTH 3/25)	2.090.003.8		3		
	(WIDTH 4/25)	2.090.004.8		4		
	(WIDTH 5/25)	2.090.005.8		5		
	(WIDTH 6/25)	2.090.006.8		6		
	MODULE KIT (EMPTY MODULE,1 UNIT WIDTH)	9005-1	NUCL. ENTERPRISES	1	/71	
	(EMPTY MODULE,2 UNIT WIDTH)	9005-2		2	/71	
	CAMAC COMPATIBLE MODULE (EMPTY MODULE,1 UNIT WIDTH)	NSI 875 DM	NUCL. SPECIALTIES	1	/70	
	(2 UNIT WIDTH)			2		
	(3 UNIT WIDTH)			3		
	CAMAC MODULE (EMPTY MODULE HARDWARE, SPACERS ESTABLISH MODULE WIDTH)	NSI 875 CM-100	NUCL. SPECIALTIES			(5)
	TIROIR MODULAIRE (W=1/25)	9905-1-L	CSL	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	
N	EMPTY MODULE, 1 UNIT		POLON	1	/71	
N	(2 UNITS)			2		
N	(3 UNITS)			3		
N	(4 UNITS)			4		
	EMPTY MODULE 1 UNIT	CCA 1	RCT	1	/70	
	2 UNITS	CCA 2		2		
	3 UNITS	CCA 3		3		
	4 UNITS	CCA 4		4		
	MODULE HARDWARE (EMPTY MODULE, W=1/25)		STNC 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)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	TIROIR MODULAIRE POUR COMMANDE	9905-TC-1	OSL	1	/71	
	TIROIR MODULAIRE A CARTES BASCULANTES	9905-TCB2	OSL	2	/71	
	(EMPTY MODULE WITH HINGED CARDS, W=2/25)					
	(SAME, W=3/25)	9905-TCB3		3	/71	
	TIROIR MODULAIRE DE COMMANDE	TCM 525	TRANSRACK	1	/70	
	(SUPPLY CONTROL MODULE)					
	CAMAC HARDWARE	CH-001	KINETIC SYSTEMS	1	/71	(4)
	KLUGE CARD (FOR CREATING YOUR OWN CAMAC	2000	KINETIC SYSTEMS	1	/71	(4)
	MODULES)					
	BLANK MODULE(COMPLETE WITH PRINTED BOARD	BM 2020/1U	SEN	1	/70	
	FOR 69 INTEGRATED CIRCUITS,1 U WIDTH)					
	(SAME,2U WIDTH)	BM 2020/2U		2	/70	
	BLANK MODULE WITH 60 WIRE-WRAP SOCKETS	WW-001	TECHCAL	2	/72	
	BLANK MODULE WITH 56 WIRE-WRAP SOCKETS	WW-002		2	/72	
	AND COMPLETE DECODING OF A AND F LINES					
	CAMAC-UNIVERSALKARTE (PRINTED CARD MODU-	DO 200-2900	DORNIER	2	/71	
	LE WITH 28 14-PIN + 28 16-PIN SOCKETS)					
C	CAMAC PROTOTYPE ASSEMBLY BOARDS	MX B1/MX B2	GEC-ELLIOTT	NA	/71	
	(MX B1 HAS 68 SITES, MX B2 HAS 80 SITES)					
	(MX B3 HAS 68 SITES,MX B4 HAS 80 SITES,	MX B3/MX B4		NA	/71	
	MX B3/MX B4 INCLUDE 5V CIRCUIT)					
	GENERAL PURPOSE IC PATCHBOARD (MAX 33	CAMAC CG 164	GSPK	NA	/70	(2)
	14/16-PIN AND 5 24-PIN DIP,WIRE WRAP)					
	PRINTED CIRCUIT TEST BOARD	10	JORWAY	NA	/71	
	EXPERIMENTIERPLATTE	4.000.002.0	KNUERR	NA	/70	
	(PRINTED CIRCUIT BOARD)					
	MODULE PRINTED CIRCUIT BOARDS(TAKE 24,16	CBP 1	RDT	NA	/72	
	OR 14 PIN, ON THE WHOLE 1092 PINS)					
	(SAME, WITH MINI-WRAP TO OV AND +6V)	CBP 2		NA	/72	
	EXPERIMENT PLATE	C 72468-A453-A1	SIEMENS	0		
	CONTROLEUR SORTIE DATAWAY		TRANSRACK	1	/70	
	(DATAWAY TEST MODULE)					
	CARTE CIRCUIT IMPRIME CAMAC		TRANSRACK	NA	/70	
	(PRINTED CIRCUIT BOARD FOR CAMAC MODULE)					
	CAMAC PRINTED CARD		KNUERR			(5)

DATAWAY COMPONENTS

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	DATAWAY CONNECTOR, EDGE TYPE II	163633	AMP-HOLLAND		/70	
	DATAWAY CONNECTOR,FLOWSOLDER TERMINATION	R500014800000000	CARR FASTENER		/70	
	(ADD MOUNTING BRACKETS R500014900000000)					
	MINI WRAP TERMINATION	R500016800000000			/70	
	SOLDER SLOT TERMINATION				/70	
C	CONNECTEUR,FUTS DROITS	KF86 254 BED T	FRB CONNECTRON		/70	
	(DATAWAY CONNECTOR,STRAIGHT PINS)					
C	FUTS WRAPPING (WIRE WRAP PINS)	KF86 254 BEY T				
C	FUTS A SOUDER (SOLDER PINS)	KF86 254 BES T				
N	CAMAC DATAWAY CONNECTOR	G 03	ITT CANNON			(6)
	CAMAC-LEISTE(DATAWAY CONNECTOR,MINIWRAP)	4.000.000.0	KNUERR		/70	
	(SOLDER PINS)	4.000.001.0				
	DATAWAY CONNECTOR,MINI-WRAP	2422 061 64334	PHILIPS		/71	(5)
	BOARD SOLDER	2422 061 64354				(5)
	WIRE-SOLDER	2422 061 64314				(5)
	DATAWAY MALE CONNECTOR (MATING THE CRATE	2422 060 14314	PHILIPS			(5)
	MOUNTED 86-WAY CONNECTOR SOCKET)					
	DATAWAY CONNECTOR (MINIWRAP)	EAA 043 D301	SABCA		/71	(2)
	CONNECTEUR 254 DOUBLE FACE	254 DF 43 AWV	SOCAPEX		/70	
	(DATAWAY CONNECTOR,WIRE WRAP)					
	(MOTHERBOARD SOLDER)	254 DF 43 AYV			/70	
	(WIRE SOLDER)	254 DF 43 AZV			/70	
C	DATAWAY CONNECTOR (MINI-WRAP)	8606 86 21 15 000	SOURIAU		/71	
N	(WIRE-SOLDER)	8606 86 21 10 000				
N	(FLOW SOLDER)	8606 86 21 14 000				
	DATAWAY CONNECTOR (*=2 FLOW SOLDER,*=3	C 288* CSP 221	UECL		/71	
	SOLDER LUGS,*=4 MINIWRAP,AU PLATING)					
	(FLOW SOLDER,NI + AU PLATING)	C 2885 CSP 221				
	(13 MINIWRAP CONTACTS,OTHER ARE FLOW	C 2886 CSP 221				
	SOLDER,NI + AU PLATING)					
	(*=7 MINIWRAP,*=8 SOLDER LUGS,	C 288* CSP 221				
	NI + AU PLATING)					
	MOUNTING BRACKETS FOR ABOVE	C 8523				

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	DATAWAY SOCKET (MOTHERBOARD COMPLETE WITH 25 CONNECTORS)	CIM	RDT		/70	
	DATAWAY ASSEMBLY (FILM WIRE PACKAGING)		MB METALS		/71	(3)
	DATAWAY MINI WRAPPING (MOTHERBOARD WITH 25 DATAWAY CONNECTORS)	J/DW	SAPHYMO-SRAT		/71	
	CAMAC MULTILAYER (DATAWAY MOTHERBOARD)	CM-8-69	TECH AND TEL		/71	

BRANCH HIGHWAY COMPONENTS

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	BRANCH HIGHWAY CONNECTOR (FIXED MEMBER,SOCKET MOULDING)	WSS0132S00BN000	EMIHUS-SABCA		/70	
	(FREE MEMBER,PIN MOULDING, PXX YYY SELECTS JACKSCREW)	WSS0132PXXBNYYY				
	HOOD (FOR FREE MEMBER)	WAC 0132 H005				
	BRANCH HIGHWAY CABLE ASSEMBLY (COMPLETE WITH CONNECTORS, LENGTH 27 CM)	BHC 27	BENNEY		/72	
	(SAME, XXX=LENGTH IN CM, 040,100 ETC)	BHC XXX			/72	
	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 (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	
N	(OTHER LENGTHS TO SPECIAL ORDER)				/72	
	BRANCH CABLE WITH CONNECTOR (1.5 FT LONG)		JORWAY		/71	
	BRANCH HIGHWAY CABLE ASSEMBLY (WITH CONNECTORS,27 CM LONG)	CC 66 POL PB-27	SABCA		/71	
	(XX CM LONG,PVC JACKET)	CC 66 PCL PB-XX				
	CABLE POUR BRANCH HIGHWAY (66 PAIRES TORSADEES,66 TWISTED PAIRS)	CL 90	SAIP-CRC		/71	
	BRANCH HIGHWAY CABLES(COMPLETE WITH CONNECTOR,XXX = LENGTH IN METERS)	2000/S/0132/XXX	TEKDATA		/71	(4)
C	EXTENDED BRANCH CABLE (LOW COST TELEPHONE CABLE FOR LONG BRANCH RUNS)	EBC XXXX	GEC-ELLIOTT		/72	
	BRANCH HIGHWAY CABLE (132-WAY)	LIY-Y72X2X0.088	LEONISCHE		/72	
	CABLE FOR BRANCH HIGHWAY (PVC JACKET)	132 PE 189	PRECICABLE ECLR		/71	
	(BRAIDED RILSAN JACKET)	132 PE 210				
N	(MEPLAT 20MMX10.8MM,GAINE PVC NOIR)	132 PE 291			/72	
	BRANCH HIGHWAY CABLE ONLY (PLAIN PVC JACKET)	66 POL PB	SABCA		/71	
	CABLE EXTENSION MODULE (JOINS TWO BRANCH HIGHWAY CABLES)	CD 18106	EMIHUS		/72	

OTHER STANDARD CAMAC COMPONENTS

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	COAXIAL CONNECTOR	RA 00 C50	LEMO		/70	(4)
C	52-WAY DOUBLE DENSITY CONNECTOR (FIXED MEMBER WITH PINS.LAM GRADER CONNECTOR)	2 DB 52 P	ITT CANNON		/70	
	LAM GRADER CABLE (20CM, WITH CONNECTORS)	LGC 20	GEC-ELLIOTT		/72	
	(40CM, WITH CONNECTORS)	LGC 40			/72	

Note

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

INDEX OF MANUFACTURERS

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Elisabethenstrasse 3, Postfach 830
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Elliott – See GEC-Elliott

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Emihus-SABCA
See respectively Emihus and SABCA

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Zjednoczone Zaklady Urzadzen
Jadrowych Polon, Bjuro Zbytu
Warszawa, Poland

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The entries in this bibliography are principally obtained from KFK Reports 1471 and 1671 with the kind permission of the author (I. Tradowsky-Thal). The Secretary of the ESONE Committee, Dr. W. Becker will be pleased to receive copies of any new CAMAC literature for the Committee's Library and inclusion in future editions of this CAMAC bibliography.

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

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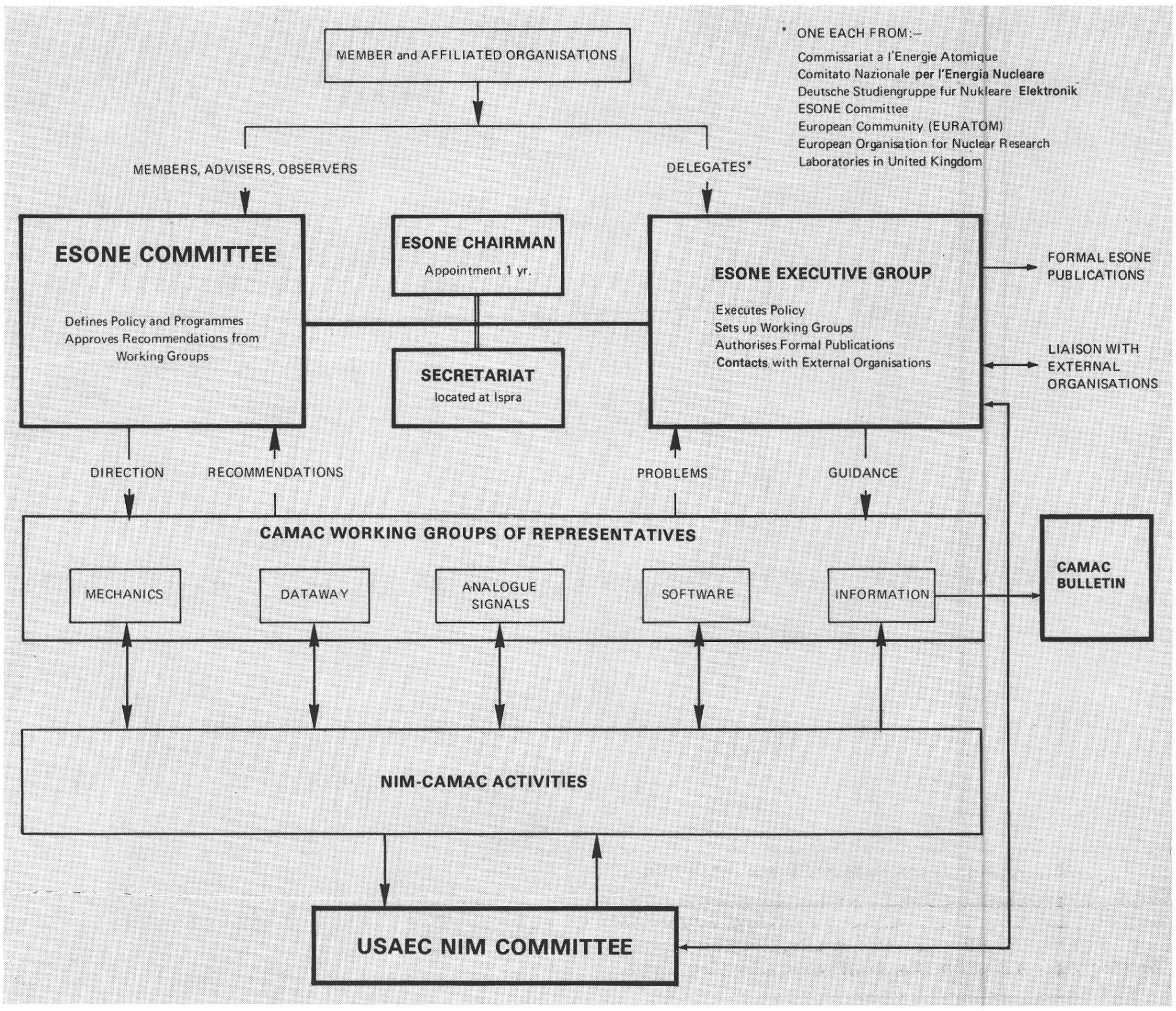

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