CAMAC
bulletin

A publication
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ESONE Committee

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WHAT IS CAMAC?

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

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

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

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

PRINCIPAL CONTENTS OF PREVIOUS CAMAC BULLETIN ISSUES

CONTRIBUTIONS TO FUTURE ISSUES*

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

Application Notes, Development Activities, Laboratory Reviews and Software:	Dr. W. Attwenger, SGAE, A-1082 Wien VIII, Lenaugasse 10, Austria.
New Products and Manufacturer News:	Dr. H. Meyer, CBNM Euratom, Steenweg naar Retie, B-2440 Geel, Belgium.
Product Guide:	Mr. O. Ph. Nicolaysen, N.P. Division, CERN, CH-1211 Geneva 23, Switzerland.
Bibliography and any ESONE News Items, etc.:	Dr. W. Becker, JRC Euratom, I-21020 Ispra (Varese), Italy.

* *DEADLINES FOR SUBMISSION* **(issue No. 11)**
For articles and New Products: 17.6.74
For Short News: 2.9.74
For Product Guide: 30.9.74

On the cover: A characteristic landmark near Petten in the Netherlands. The ESONE Committee held its Annual General Assembly at the Reactor Centrum Nederland, Petten in September 1969.

CAMAC
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U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards
Washington, D.C. 20234

OFFICE OF THE DIRECTOR

The modern world is marked by complex technology, massive international trade, and increasing human interdependence. In such a world, standardization plays a vital role.

Lack of adequate standardization had long been a serious shortcoming in the instrumentation field. The very real need for such standardization accounted for the dramatic world-wide acceptance of the NIM standard instrumentation system very soon after its introduction nearly ten years ago. With increased automation, it became apparent that a complementary computer-oriented instrumentation system was necessary and CAMAC was developed to fill that need.

The advantages of standardized instrumentation systems, including savings in cost and manpower, as well as improved reliability and flexibility in optimization and structuring of instrumentation systems, have become apparent. Clearly, society can no longer afford the wasteful luxury of the complete custom engineering that has been common in the past. It is important to observe that diversity of applications is no barrier to standardization.

The productive and friendly collaboration of the ESONE Committee of European Laboratories and the U.S. AEC NIM Committee has been gratifying and I am pleased that the U.S. National Bureau of Standards has been an active participant.

Richard W. Roberts
Director
National Bureau of Standards

Richard W. Roberts

BIOGRAPHICAL NOTE

Richard W. Roberts became the 7th Director of NBS in February 1973. He has an international reputation as a research scientist in ultra-high vacuum technology and the physical and chemical properties of atomically clean metal surfaces. Dr. Roberts is a member of the American Chemical Society, the American Physical Society, the Washington Philosophical Society, the New York Academy of Sciences, the American Association for the Advancement of Sciences, Phi Beta Kappa and Sigma Xi. He is a senior member of the American Vacuum Society, a Fellow of the American Institute of Chemists, and Associate Editor of the Annual Review of Materials Science.

Dr. Roberts, progressed to the University of Rochester from his home town of Buffalo, New York, receiving his batchelor's degree with distinction in 1956. After receiving a doctorate in physical chemistry at Brown University (1959), he served as a National Academy of Sciences Post-doctoral Fellow at the National Bureau of Standards (NBS) prior to joining the General Electric Company in 1960. He served as manager of Materials Science and Engineering at GE's R. and D. Center in Schenectady, N.Y. until he assumed the Directorship of NBS.

HIGHLIGHTS OF ESONE ANNUAL GENERAL ASSEMBLY

LUXEMBOURG DEC. 6-7, 1973

The Assembly was convened immediately after the closing of the 1st International Symposium on 'CAMAC in Real-Time Computer Applications' and was therefore well attended by the members and observers.

Dr. H. Meyer of CBNM-JRC (CEC-Euratom), GEEL, Belgium was elected Chairman for the period 1973/74. The annual review by the retiring chairman, Prof. B. Rispoli, CNEN, ROME, Italy, had welcomed the new members from the Universities of Oxford, York and Haut Rhin (Mulhouse); the 'Centre des Recherches Nucléaires', Strasbourg and the 'Laboratoire des Applications Électroniques de l'École d'Ingénieurs Physiciens', Strasbourg.

Mr. H. Klessmann, as Chairman of the Dataway Working Group, submitted the joint NIM-ESONE document 'CAMAC Serial System Organization—A Description' NDWG 73-10 and EDWG 25/73. After careful discussion, the Assembly unanimously agreed that the Executive Group should authorise publication of this document as amended by the points raised in EDWG 26/73, the object of which was to allow access to the N-lines.

Status reports from the other Working Groups led to lively discussions, the principal conclusions of which were:

(a) The aims of the Software Working Group and the present status of the CAMAC Intermediate Language (IML) were presented, and the Assembly noted that a final document would be likely to appear in mid—1974.

(b) The document, 'CAMAC—Specification of Amplitude Analogue Signals' Draft Text, Berlin 21st October 1973 should be authorised for publication by the Executive Group subject to rewording to make clear that it referred to signals on 50 ohm lines, and subject to agreement by the NIM Committee. (This document revises and extends the present specification EUR 5100 (1972)).

(c) The Mechanics Working Group should actively investigate useful recommendations for non-nuclear applications of CAMAC like for instance, means of connecting multi-signal lines via the front panel of a CAMAC unit in a way suitable for industrial process control environments.

Prof. Rispoli reported that the Executive Group had established a 'rapport' with the Commission of the European Communities in collaboration with the CAMAC Supply Industry and the first outcome of this had been the Symposium in addition, of course, to continued support of the CAMAC Bulletin.

The Executive Group had been considering also how to adapt to the changing circumstances of maintaining and promoting CAMAC now that the major part of the task of specifying CAMAC had been completed. Several proposals were being discussed, and Mr. H. Bisby explained to the Assembly a proposal that would encourage autonomous regional (or National) CAMAC Associations (of Users and Suppliers) supported by common facilities (maintenance of specifications, Bulletin, Symposium, etc.) from an international CAMAC council. The Assembly called a preliminary meeting of interested persons with the object of forming a Study Group to consider the topic further and report back at the next General Assembly.

Liaison with the International Electrotechnical Commission was continuing, and a document dealing with the dimensions of CAMAC units was already at the 6-month voting stage. It was also possible that IEC documents embracing the whole contents of EUR 4100 and EUR 4600 would be prepared separately as Central Office documents during 1974.

The Assembly accepted the invitation of Dr. R. Trechcinski to have the next Annual General Assembly in Warsaw during September 1974, and agreed to ask CAMAC Supply Companies to support an exhibition that would be held concurrently with the Assembly meetings.

OBITUARY NOTICE

PIETER CORNELIS VAN DEN BERG†

The ESONE Committee have received with great sadness the news of Pieter's untimely death on the 9th January 1974, after a period of illness.

Born in Schipluiden, near Delft, on 22nd November 1929 he completed his studies in Physics at the Technical University of Delft in 1956. In that year he joined RCN Petten and spent some time in Norway instrumenting the Halden reactor. Later in 1957 he assisted with the design of the HFR reactor of AMF Washington and with this experience he was made responsible for the instrumentation of the HFR reactor at Petten, on his return. In 1960 he became Leader of the Electronics and Instrumentation Group at Petten.

Pieter was one of the earliest members of the ESONE Committee and was a staunch supporter of standardisation that would enable him to get on with the more exciting applications of electronics. In fact, as far as the record goes, he was the first in the world with a CAMAC system doing a useful job of work.

All who knew Pieter will remember him for his gentleness in discussions on technical matters and yet his firm opinions on how best to solve some difficult problem or other. Those of us who were honoured to have been introduced to his private life also knew him as a true family man with many interests outside his scientific career.

APPLICATION NOTES

MULTILAB — A LABORATORY AUTOMATION SYSTEM BASED ON MODUS 4 AND CAMAC

by

P. M. HILLS

Computer Technology Ltd, Hemel Hempstead, England

Received 29th October 1973

SUMMARY The time-sharing laboratory automation system MULTILAB uses CAMAC and one or more Modular One computers. The history of such schemes is discussed, together with system characteristics, typical CAMAC interfaces, performance and software hierarchy.

INTRODUCTION

There are substantial advantages to be gained by the use of a centralised computer system to control the various instruments in an analytical laboratory. Although analytical instruments may require massive computer capability for short bursts, they do not make large total demands on computer power and so are ideal for control in a time sharing mode. The Multilab system is designed to provide an operating environment specifically for the analytical chemist, with on-line control of standard instrument types, and a range of application software. Multilab is based upon the use of one or more Modular One processors, Modus 4 software and CAMAC, an interfacing system which complements the inherent modularity of the rest of the system.

History

Multilab is being developed jointly by Computer Technology (CTL) and the AERE at Harwell and is the culmination of over four years of co-operation between them. In 1969, Harwell and CTL, under partial sponsorship from the Ministry of Technology, sought to produce a time-sharing data acquisition system for use in the analytical chemistry laboratories of Government and educational establishments. At the same time numerous other computer companies interested in this field had produced, or were about to produce, similar applications of their machines. In the event, few of the projects completed over the next few years were a total success and the laboratory automation market was virtually taken over by instrument manufacturers who offered to supply dedicated non time-sharing systems for control of a specific group of laboratory instruments. These systems were based upon mini computers, and used interfacing systems of widely differing standards. CTL's own project proved that Modular One could support an extremely complicated multi-access data acquisition system but, since it was at the time based upon a special purpose executive which allowed only instrument processing, its commercial utilisation was limited. This work showed that Modular One was sufficiently powerful to perform real-time acquisition and processing with various on-line laboratory instruments; that it could simultaneously support local batch processing and allow users of the system to develop and run their own application programs in multi-access mode; and that the acquisition and processing software could be run under a general purpose executive (providing its response was adequate). These conclusions have led to the development of Multilab. The executive, together with utilities and language software, is termed MODUS 4. Its general purpose nature can be seen from the fact that MODUS 4 is the basis of all CTL's systems in scientific and commercial markets.

SYSTEM FEATURES

Multilab allows a system to have a large number of low-speed instruments operating at around 100 samples per second, typically with sixteen in concurrent use. CAMAC greatly simplifies the connection of any instrument to the computer. Fig. 1 shows a typical CAMAC interface for gas-liquid chromatograph (GLC) and nuclear magnetic resonance (NMR) instruments (For information on these and other analytical instruments see Refs 1-6). In older instruments signal levels are rarely suitable. and preamplification and filtering is usually needed.

A typical Multilab configuration is shown in Fig. 2. Multilab software consists of a suite of programs and a specialist Instrument Operating System running under MODUS 4 in processor A. It controls CAMAC, organises data acquisition, initiates applications and allows users to set up and run instrument 'jobs'.

Instruments are controlled by teleprinters or visual display units (VDU), one in each of four laboratories for example. Instrument jobs are set up by question and answer with the system. Graded levels of system dialogue are provided for both the sophisticated user of the system and the technician who has to initiate runs or sequences of runs on a production basis. The user specifies the instrument station, run parameters and the name of a new or existing file to be used to retain data. He also specifies the sequence of processing operations to be applied to the acquired data, and the peripheral device(s) upon which results are to be output. All this initial information can be preset. Standard application programs are provided for the common analytical instruments (GLC, NMR, and High Resolution Mass Spectrometers), but other applications software can be written easily by the user in Basic, Coral, Fortran or Assembler. More important, it can be compiled, edited and debugged without interfering with the operation of the rest of the system, or disturbing similar operations by colleagues working at the same time.

During low-speed instrument runs the user is able to acquire and process data from one to four high-speed instruments, operating at up to 50,000 samples per second. So far the high-speed instruments have usually been mass spectrometers operating at approximately 25 kHz. For mass spectometry, a significant realtime processing operation is per-

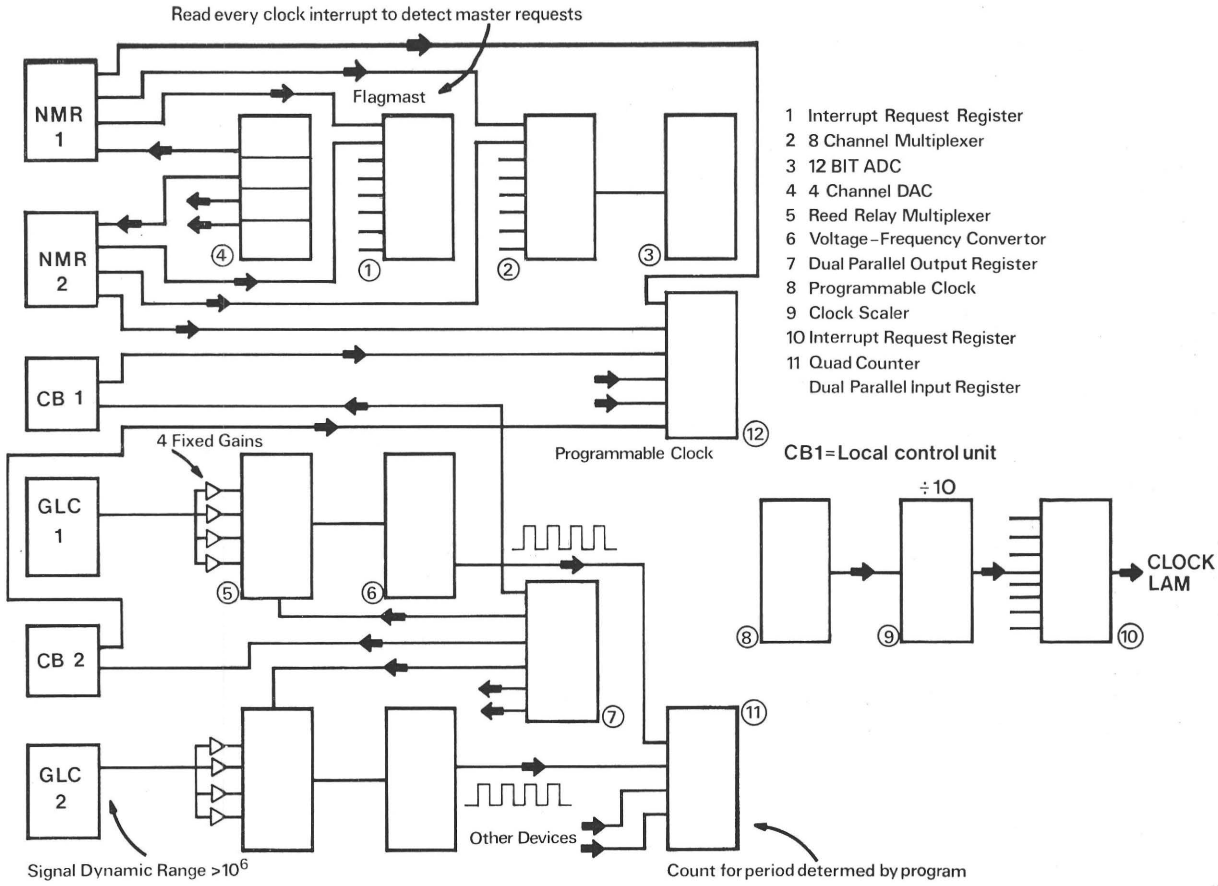


Fig. 1 Typical CAMAC Interface for NMR/GLC Instrumentation

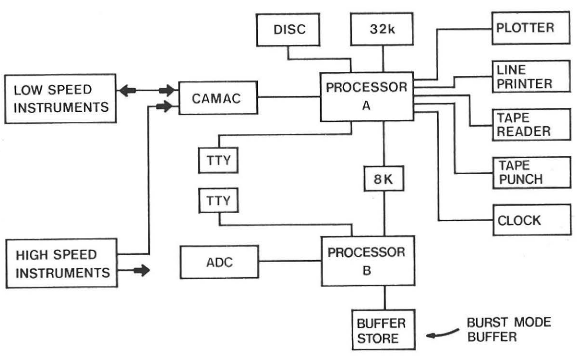


Fig. 2 Typical Multi Processor MULTILAB Configuration

formed by the dedicated Modular One computer (processor B in Fig. 2), which reduces the quantity of data stored on disc, prior to further processing. All disc transfers are initiated by processor A, in response to control signals from processor B. This ability to reduce data sets to manageable proportions, by pre-processing and subsequent real time transfer to disc, means that the system can handle sequential MS analyses of the output from a GLC, without the need for extensive storage facilities.

For really high speed operation a burst mode is provided, where all data is buffered into a dedicated semi conductor store and subsequently transferred to disc between instrument runs. Sampling rates approaching 75 kHz are attainable in this way.

High-speed devices produce considerable data management problems. There may be industrial regulations that require results to be archived for substantial periods (e.g. in drug research or production). Modular One allows intermediate storage via an exchangeable disc system (14 Mwords per pack), with long term storage on 7 or 9 track magnetic tape. The system can, if necessary, support up to 32 exchangeable disc drives on one disc controller and up to 4 transports per tape controller.

CAMAC INTERFACE

A typical MULTILAB system for a mix of instruments requiring use of ADC's is shown in Fig. 1. The continuous ADC approach (voltage to frequency conversion) is recommended where it is necessary to transmit a signal having a wide dynamic range over distances of several hundred metres in an electrically noisy environment. In such circumstances, one CAMAC quad scaler (four 24-bit counters), can handle four instruments. The dynamic range during a run is usually about 10^5, but depends upon the type of voltage to frequency converter used, and the sampling rate. In the example shown, the absolute dynamic range is extended to greater than 10^6 by preamplifiers selected by a reed relay multiplexer. The multiplexer channel is selected by control lines from a CAMAC output register. Channel selection can be performed in real time.

Instruments with high level outputs are connected by a multiplexed ADC in the conventional way, and for certain instruments closed loop measurement and control is provided by multiple DAC units, or by stepping Motor drivers.

LAM interrupt requests are graded via an interrupt request register, although normally only a clock is allowed to interrupt the processor in a MULTILAB system.

For the low-speed system, the system interrupt rate is normally 100Hz, but there is no software restriction on clock frequency and much higher rates can be serviced, dependent upon overall processor load. Sampling rates of individual instruments are requested by the user at set-up time and used to set software timers. These determine at which clock interrupt the data should be acquired. Instruments that would normally interrupt the processor to signal the availability of data are simply allowed to preset an interrupt request register which is read at the system clock rate. Hence Multilab can service 'Master' and 'Slave' devices and the overall interrupt load in minimised. The low-speed system normally has one CAMAC crate with controller. This can service up to 60 instruments, depending upon the types of device connected.

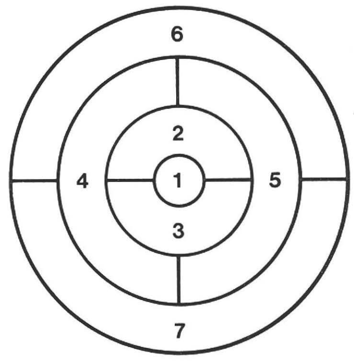
The number of instruments connected to the high speed system usually is small and a separate CAMAC system for this may not be justified; in which case the CTL high-speed multiplexed ADC is used. All the digital input/output and clock requirements of the high-speed system are performed by the low-speed CAMAC crate.

All CAMAC transfers are programmed, and the controller conforms to EUR 4100 e. In general there has been little need for autonomous transfers or for multi-crate systems. In future, with more sophisticated instruments, there may be a requirement for a controller that provides autonomous working. For Multilab applications this controller would have to be considerably more versatile than many of the existing designs, and would actually perform data processing and relieve the load on the dedicated processor, or replace it altogether. CAMAC in this role is cost effective, in that it forms part of a true parallel processing system which utilises the inherent intelligence of the CAMAC system.

PERFORMANCE

Multilab is a centralised computing system, based upon one of the most powerful midi computers available.

With the system described above there is a limitation of 50,000 samples per second for high speed ADC systems, but in future there will be a need to sample at rates greater than 100 kHz. In this area the instruments themselves will inevitably be supplied with a dedicated mini-computer, and it is unlikely that any time-sharing system, like Multilab, could compete and continue to time share. However, a centralised Multilab system, based on CAMAC, can be connected simply and cheaply to the dedicated system to allow data transfer between instrument runs. It can thus act as a data base, not only for the low-speed devices, but also for dedicated and usually very expensive instrumentation systems. A possibly more significant reason for centralisation is that, since Multilab is based upon a general purpose executive, users are able to take advantage of enhancements to the executive software. One such enhancement is the CTL Satellite Operating System (SATOS). This provides the Multilab system with remote job entry capability, allowing the user to acquire and process data from instruments, while simultaneously sending data or jobs to a larger computer via a 2400 baud communications line. Thus potentially unlimited computing power and data management facilities become available locally, and the user has the choice of local or remote batch modes of operation. Fig. 3 shows the levels of software hierarchy in such cases.



1 E4 Executive
2 Satellite Operating System *(SATOS)*
3 Basic Disc Filing System
4 Multilab Operating System
5 Multilab Applications Software
6 Program Development — Batch or Multi-Access
7 Ordinary User Programs — Batch or Multi-Access

Fig. 3 System Software Hierarchy

CONCLUSION

This article has described a centralised computing system, based upon a general purpose executive and CAMAC, that is capable of solving the problems associated with laboratory automation. The CAMAC interface system specified for this product offers significant advantages to the user in terms of flexibility, expandability, availability and low incremental cost, and is certain to enhance the performance and reputation of the whole development.

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LABORATORY REVIEWS

CAMAC AT LAMPF

by

Donald R. Machen

The Clinton P. Anderson Meson Physics Facility, Los Alamos Scientific Laboratory, New Mexico, USA

Received 26th September 1973

SUMMARY The CAMAC standard has been adopted for general use in data acquisition and control systems at the Clinton P. Anderson Meson Physics Facility, one of America's newest national laboratories. This paper is a brief description of current CAMAC activities at LAMPF.

WHAT IS LAMPF?

The Clinton P. Anderson Meson Physics Facility, commonly referred to as LAMPF, is one of Ameca's newest national facilities devoted to the pursuit of research in medium energy physics. LAMPF is a part of the Los Alamos Scientific Laboratory and is located at an elevation of some 2200 meters in the 'high country' of the southwestern United States.

The heart of LAMPF is a proton linear accelerator approximately 1 km in length, operating at energies of up to 800 MeV and an average beam intensity of up to 1 mA. The accelerator is capable of accelerating H^- ions in addition to protons.

Presently, researchers from throughout the United States and several European and Asian countries are in the throes of setting up equipment in anticipation of particle beams at the various experimental stations. All experiments are being planned with CAMAC as the interface between the data acquisition computer and the detector array.

ORGANIZATION OF A DATA ACQUISITION SYSTEM

The experimental area at LAMPF consists of three main halls in which several experiment stations are located. Each station either has or will be equiped with a data acquisition computer system (generally PDP-11/20 or 11/45 computers) and two to three CAMAC crates, operated from a rather special LAMPF-designed branch driver.

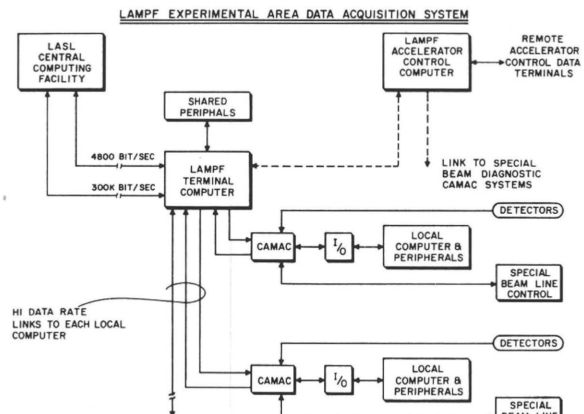

Fig. 1 LAMPF Experimental Area Data Acquisition System

In an attempt to conserve peripheral devices and also make the powerful central computing facility of the Los Alamos Scientific Laboratory (LASL) available to experimenters, a linked system of data acquisition computers was conceived. Fig. 1 indicates the basic structure of this system. All experiment-oriented data acquisition systems are coupled to a terminal computer via CAMAC data link modules. In addition, the LAMPF accelerator control computer is also coupled to the Terminal Machine. A microwave data link to the central computing facility is planned in the near future.

Data acquired by an experimenter's computer finds a temporary home on local disk or magnetic tape before being sent to the Terminal Machine peripherals, and on to the central computing facility.

CAMAC HARDWARE

Most CAMAC systems at LAMPF are configured in accordance with EUR-4600e and utilize the special LAMPF-designed branch driver noted above. This branch driver, termed the Microprogrammed Branch Driver (MBD) is, in reality, a special purpose minicomputer designed to perform CAMAC I/O functions.[1] A side benefit of this novel branch driver is its ability to execute arithmetic and logical instructions in parallel with code being executed in the controlling computer. The software overhead associated with conventional branch drivers is therefore much reduced.

The many CAMAC modules used with each experimental station are, for the most part, commercially purchased units. However, the special requirements of a number of external devices have necessitated the design of modules at LAMPF. The computer-to-computer data link mentioned above, readout modules for two designs of multiwire proportional chambers, readout modules for a multichannel pulse height analyser, a Dataway-accessed LAM-Grader for a single-crate system, and a control module for special beam profile wire-multiplexers are representative of the modules designed and constructed at LAMPF.

OTHER CAMAC SYSTEMS

In addition to the experimental station computer/CAMAC systems in the LAMPF experimental halls, two mini-computers have recently been set up in single-crate configurations (with Type-U controllers) to serve as dedicated beam diagnostics systems. These computers, with their associated CAMAC hardware, acquire beam profile information from wire profile grids located in beam lines throughout the experimental area. Information is sent to the

LAMPF accelerator control computer, via CAMAC data links, for processing and use in beam line tune-up.

In addition to the basic physics research associated with the accelerated beam at LAMPF, a biomedical facility for research and treatment of malignancies with pion radiotherapy is being constructed. The facility consists of a transport and beam diagnostics system for the pions (created when the proton beam strikes a graphite target) and two treatment rooms with their associated instrumentation. The operation of the facility is to be accomplished with a fully-configured minicomputer interfaced to the instrumentation and control hardware through an MBD-CAMAC multicrate system. Further, the computer system supports an extensive operators' console for operation of the facility.

Last, but not least, a laboratory-based single crate CAMAC system (Type-U controller) is used extensively in module development, system checkout and maintenance of CAMAC and nuclear instrumentation hardware. The small computer coupled to this CAMAC system is programmed in an 'easy to use' interpretive language so that laboratory technicians can quickly set up a sequence of operations without the coding problems generally-associated with a small general purpose digital computer.

CONCLUSIONS

Looking back, the decision to adopt the CAMAC standard has proven to be the correct decision for the LAMPF experimental area systems. A large national facility cannot hope to operate any reasonable data acquisition complex without a well-known and workable set of standards through which the systems are configured. This applies not only to the instrumentation and interface devices, but to the computers and computer software as well.

In the future, new major beam lines will utilize the forthcoming CAMAC Serial System standard[2] for implementation of controls. Furthermore, if the CAMAC standard in its present state had existed in North America five or six years ago, a great deal of the main accelerator control would have been accomplished through CAMAC. However, for a facility such as LAMPF, only a Serial Standard would have been acceptable for the accelerator control.

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2. Barnes, R. C. M., The CAMAC Serial Highway – A Preview. *CAMAC Bulletin*, No. 8, November 1973, pp. 5-6.

ESONE ANNOUNCEMENTS

CAMAC LIBRARY

To enable the ESONE Secretariat to complete and maintain its CAMAC Bibliography and Library facilities, which includes making loans on request, all authors of publications concerned with CAMAC are kindly requested to send TWO copies to the Secretary:

Dr. W. Becker,
JRC EURATOM,
I-21020 ISPRA (Varese),
Italy.

CAMAC SERIAL SYSTEM

The document 'CAMAC Serial System Organization—A Description', prepared jointly by the Dataway Working Groups of the NIM and ESONE Committees, was presented to the General Assembly of the ESONE Committee on 6th December 1973. It had previously been endorsed by the NIM Committee on 14th November 1973. The ESONE Committee endorsed this document, identified by Working Group references NDWG 73-10 and EDWG 25/73, as the basis for a formal specification, subject to the amendments shown in EDWG 26/73 which had already been accepted in principle by the NIM Committee.

The amended document thus constitutes the best available information on the Serial System, until the formal specification is published. At this stage all designers using this information should maintain close contact with the NIM or ESONE Dataway Working Group, as appropriate, and should seek advice about any omission or ambiguities that are found in the document.

All ESONE Committee members should have received one copy of EDWG 25/73 and the amendments EDWG 26/73. The amended document is being published by the NIM Committee as TID 26488 and by the ESONE Committee as ESONE/SH/01.

Copies of ESONE/SH/01, 'CAMAC Serial System Organization—A Description' can be obtained from the ESONE Secretariat:

Dr. W. Becker, JRC EURATOM
I-21020 ISPRA (Italy)

DEVELOPMENT ACTIVITIES

A CAMAC TIME-OF-FLIGHT SCALER

1

by

D. A. Boyce and D. V. Morris

Nuclear Physics Division, Atomic Energy Research Establishment, Harwell, England

Received 3rd August 1973

SUMMARY This versatile 16-bit scaler is used for two-parameter neutron time-of-flight measurements at a pulsed 45 MeV electron linear accelerator. Correlated words representing flight times (measured by the scaler) and particle energies (measured by an analogue-to-digital converter) are transferred by a CAMAC system to a PDP-11/45 computer.

INTRODUCTION

The time-of-flight scaler described here is a modified version of one[1] used for neutron studies with the Harwell Linear Accelerator, and interfaced directly to a PDP 11/45 computer through a DEC DR11B standard peripheral controller.

The time-of-flight technique measures the time taken for neutrons to traverse a flight path, in order to determine their velocity and hence their energy. A time-of-flight scaler is used to count clock pulses, starting when a burst of neutrons enters the flight path. The count either stops when the first neutron is detected at the end of the flight path (single-shot mode), or continues while the scaler is read 'on the fly' as successive neutrons reach the detector (multishot mode).

The CAMAC version of this scaler was required for a two-parameter experiment where the first parameter relates to the neutron flight time and the second to the scattered particle energy. The particle energy is measured by a non-CAMAC analogue/digital converter interfaced through a CAMAC input module. Gating must be provided to maintain correlation between the data relating to the two parameters, and this is done in the present experiment by operating the ADC in an external gating mode.

Data from the ADC and the time scaler are transferred to the computer through the CAMAC system by normal demand-handling methods. When a LAM signal appears due to the detection of a neutron (indicating that the scaler contains a word for transfer) the computer program is arranged to read the ADC word and the scaler word into adjacent store locations. Two locations are necessary owing to the word length of the computer.

A Nuclear Enterprises 9030/9032 controller is used to couple the CAMAC system to the computer.

SCALER DESIGN

Fig. 1 shows the general arrangement of the scaler. The unit is of 16-bit capacity and has the following facilities:

- Multishot or single shot operation up to 16 MHz clock rate;
- Dead time 100 ns or 1 time-channel;
- Facilities for labelling detector outputs and sample changer position, but at the expense of timing bits;
- Channel widths can be pre-programmed.

The unit is constructed in a double-width module.

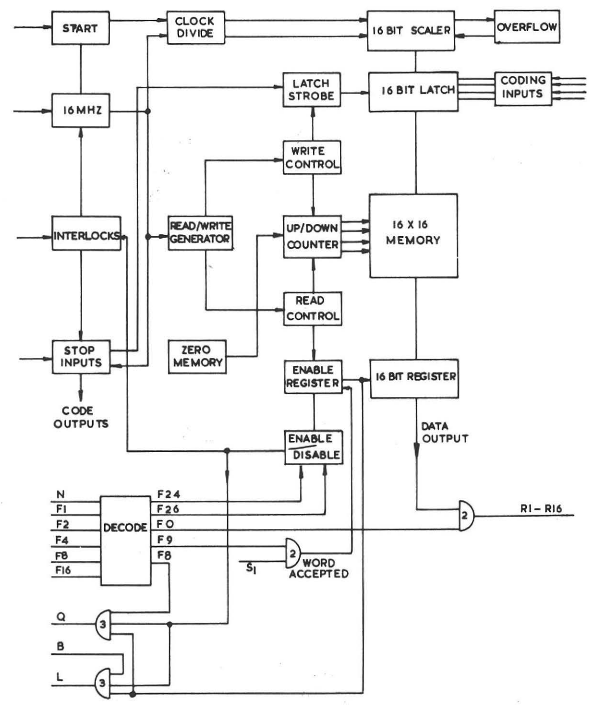

Fig. 1 CAMAC Time-of-Flight Scaler

OPERATION

In general the scaler is enabled by a START pulse from the Linear Accelerator timing circuits at a rate of 200 Hz. The scaler will then clock synchronously up to a predetermined overflow level. Stop signals initiated by the detection of neutrons cause the contents of the scaler to be transferred in parallel to a multi-word buffer store 'on the fly'. The number of Stop signals that can be accepted in the period between machine start pulses (5 ms) is limited only by the CAMAC/Computer cycle time, the buffer store and, in this application, by the dead time of the ADC.

In normal operation the arrival of the 1st Stop pulse will transfer the scaler contents to a 1-word 16-bit latch and then to the 1st buffer store location. Assuming the output register is empty, then this word will be transferred to the output within 100 nS and a LAM sent to the computer. On receipt of LAM the scaler and the ADC are read by means of F(O). If the buffer memory contains further words in other locations then the output register is reloaded and the cycle repeated. Control logic keeps the output register full whenever there is a word in the buffer memory awaiting processing. Delay in transferring data to the computer will eventually cause the buffer to fill if further Stop pulses arrive. Provision has been made for counting the Stop pulses arriving when the 16 word buffer memory is full. The transfer of words from the scaler to the next sequential memory location is achieved by means of an Up/Down counter incremented by Stop pulses and decremented by a reset pulse from the computer.

CAMAC COMMANDS

The contents of the output register can be read non-destructively by F (0), and can be cleared (and replaced by the next word from the buffer) by F (9).

When the scaler is used in a single shot mode it is disabled by F(24) and enabled by F(26). Circuits have also been included for Command Accepted decoding.

CONCLUSION

The scaler is a versatile unit and should have a wide range of applications outside the specialised field for which it has been made, especially since no commercial equivalent is available.

REFERENCE

1. Morris, D.V., Bruce – Buffer Register Under Computer Edict. AERE Harwell England, Report AERE-R 7556, October 1973.

2

A TELETYPE-CONTROLLED CAMAC BRANCH DRIVER

by

D. Kollbach

Hahn-Meitner-Institut für Kernforschung Berlin GmbH, Germany

Received 5th October 1973

SUMMARY This branch driver is an interface between a Teletype machine and the CAMAC Branch Highway. It is used for testing and servicing CAMAC equipment. A repetitive mode of operation is available to support the use of an oscilloscope.

INTRODUCTION

Manual controllers requiring no computer have proved to be very useful for testing and servicing CAMAC equipment such as modules and crate controllers. However, controllers with many switches and push-buttons are inconvenient to use. Consequently, a branch driver (TTY-BDC) was developed which is operated via a teletype machine (TTY) as shown in Fig. 1. Its advantages are:

- no computer time is required, and tests in any laboratory are facilitated;
- very easy handling, even for users not acquainted with computers or CAMAC in detail;
- since the tape reader of the Teletype can drive the BDC, complete programs can be performed;
- a record of the CAMAC commands, explanatory text, and the response of the system (Q, X, Read data etc.) is printed.

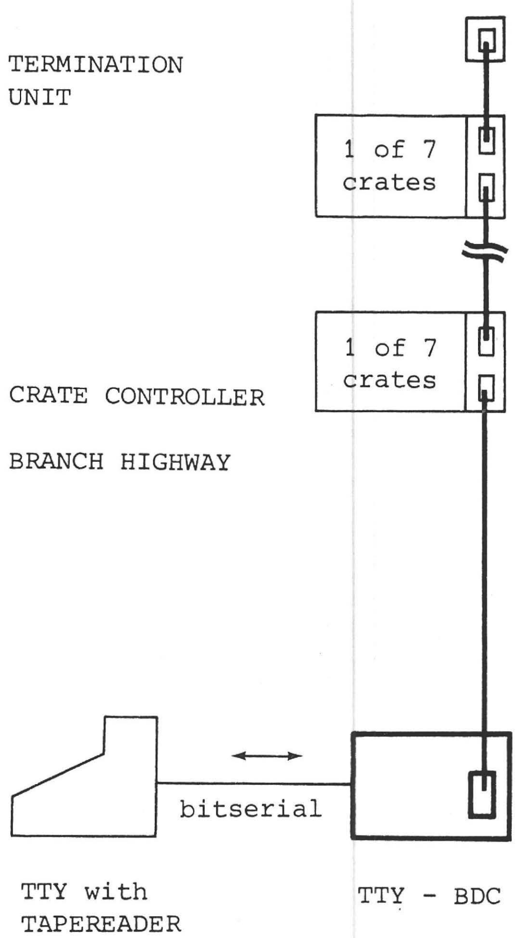

Fig. 1 CAMAC System Configuration with the Teletype Branch Driver Controller

BASIC FUNCTION AND BLOCK DIAGRAM

The TTY-BDC (Fig. 2) is operated by means of the teletypewriter via the serial I/O-port. The characters from the teletype are decoded; letters adress the appropriate registers and the following numerals load the addressed register. For example, the instruction 'F 26', writes the binary pattern 11010 into the function code register. The registers may be loaded in any sequence and may also be loaded separately, i.e., if a branch operation uses partly the same C,N,A,F, (W) code as the preceding operation, only the different information need be input.

A semicolon terminates the input of information and triggers the required action, e.g. a branch operation. Blanks are ignored and may be inserted anywhere. The 'print timing and control' circuit organises the storing and printing of information received from the branch (e.g. read-data, BQ, BX) in a word format suitable for a TTY-machine.

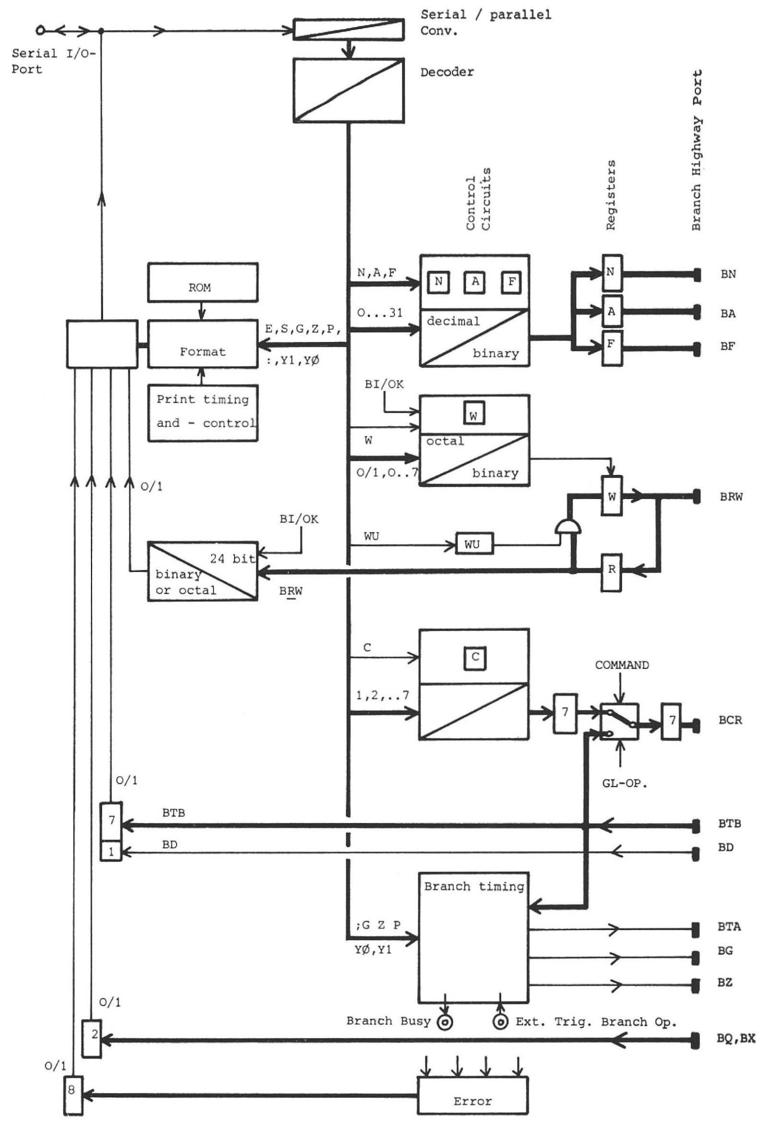

Fig. 2 Block Diagram of the TTY-BDC

OPERATIONS

Branch Initialise

Branch Initialise (BZ) is initiated by typing the letter Z.

Command Mode Operations

The C,N,A,F registers are loaded as described above by addressing the appropriate register with a letter and adding a decimal number (for easy handling),

e.g. C6, N23, A15,F∅;

This calls for a read-operation F(∅) which addresses subaddress 15 of the module at station 23 in crate No. 6.
Multicrate addressing is possible,

e.g. C 1 34,

addresses the crates BCR(1), BCR(3), and BCR(4) simultaneously.

Data are presented in binary or octal code, according to the state of a bistable which is controlled by the instructions 'BI' and 'OK',

Write-data may consist of less than 24 bits or less than 8 characters in octal notation; in this case, the controller interprets the data to be placed rightbound. In binary mode, for example: W 1∅∅ ∅1∅ generates the write-data word,

∅∅∅ ∅∅∅ ∅∅∅ ∅∅∅ ∅∅∅ ∅∅∅ 1∅∅ ∅1∅
BRW24 BRW1

In octal mode 'W 42' results in the same write-data word. *Read data* are printed in octal or binary code according to the state of the BI/OK bistable.

Data transfer

Data which are stored in the read-data register by a read operation may be transferred into the write-data register by the instruction 'WU'. So this word can easily be written into another module.

Status information

In command mode operations, the status responses BQ and BX are printed automatically.

Example, showing three command mode operations:

C1, N2, A, F16, OK, W 7310;
Q 1 X 0
Write the DATA ∅∅∅∅731∅ into module 2;
Response ([8]) Q=1, X=∅ old (module)
F;
Q 1 X 0 R 0 0 0 0 7 3 1 0
Read from the same module of the same crate
BI;
Q 1 X 0 R 000 000 000 000 111 011 001 000
Put the controller into the BINARY DATA mode, perform the same Read-Command

Graded-L-Operations

A GL-Operation is performed after typing the instruction 'G;' (Graded-L Operation). The controller automatically addresses all on-line crates. Then the actual GL-pattern is received and printed.

```
G;
 L 000 000 000 000 000 000 000 011
    ↑                               ↑
GL24                              GL1
```

Branch Status, Branch Demand

The state of the BTB-lines and the BD line is strobed and printed using the instruction 'S'; (Status), e.g.

```
  S;
   S  0  0  0  1  0  1  1 / 1
      |  |  |  |  |  |  |   |
BTB   7  6  5  4  3  2  1   |
                            BD
```

This special operation may also be performed when the Branch is locked up (e.g., if in a command operation a non existent or off-line crate is addressed). In this case, the Timing circuit of the Branch Driver is unlocked after strobing the state of the BTB and BD lines.

Special Test-Branch Operations

For special tests, (such as finding out whether BZ really has priority over all other signals on the branch) a command together with BG or BZ, or a GL-Operation together with BZ, may be performed using the instruction 'P', (priority suppression) together with the required operations,

e.g. Z, CL, N3, A∅, F∅, P;

performs a command operation together with the Initialise signal. The crate controller must not respond to the command; it must perform an Initialise Operation.

Cyclic Operation

Cyclic operation is a useful feature especially for fault detection with an oscilloscope. The cyclic mode of operation is switched on or off by the instruction 'Yl', or 'Y0', respectively. In this mode neither Q, X, nor Read-data are printed. The repetition rate is about 30 kHz. An input for external triggering of Branch Operations is also provided.

Commentary Mode

Comments which do not affect the content of the registers in the BDC are written between apostrophes.

```
C1, N30, A10, F26,  'ENABLE BRANCH DEMAND' ;
 Q 0   X 0
```

Error Pattern

Errors, such as those due to mis-operation or to branch operations that lock-up or time-out, are stored in an 8-bit register and indicated by printing 'M' (mistake).

The 8 bit pattern may be read by typing E;

```
B1, W 001 110 777;
 Q 0   X 0   H
E;
 E    0   1   0   0   0   0   0   0
```

this means: Input of octal data in BINARY MODE

Operations without printing

Normally, commands are terminated by a semicolon. The required operation is performed and a print-out (e.g. BQ, BX, Read-data) follows.

If operations are to be performed without printing, a colon and a semicolon are typed, e.g.

#Z; C1, N12, A, F26:; N2, F9:; σ F:; WU, F16, N12:;

This mode of operation has proved to be convenient especially when the system is driven by a punched tape.

GENERAL REMARKS

The TTY-BDC is built into a 3/12 NIM-module and contains about 300 ICs.

The print timing and control circuit (see Fig. 2) is implemented in conventional manner with counters, decoders and operating-mode flipflops. The read-only-memory which contains the code for all characters to be printed consists of a diode matrix. In the control circuits, some arithmetic units are incorporated for decimal-to-binary, octal-to-binary, and binary-to-octal conversion.

Not every feature of the TTY-BDC has been mentioned.

NEWS

PURDUE WORKSHOP ACTIVITIES

At the International Purdue Workshop on Industrial Computer Systems, held November 26-29, 1973, at Purdue University, there was extensive discussion of the need for one or more standard data highways for use in industrial control systems. The two systems which received the most attention were CAMAC and the Hewlett Packard highway. The Workshop's Interface and Data Transmission Committee took advantage of the presence of representativities of Imperial Chemical Industries and of the USAEC NIM Committee to receive informal descriptions of ICI's MEDIA system and the CAMAC Serial Highway. During 1974 the committee will attempt to become familiar with various existing interface systems and develop criteria for judging them.

With the cooperation of a number of organizations, and some heroic work on the part of a few people, a computer-driven demonstration was set up on the Purdue campus in conjunction with the Workshop. The demonstration consisted of a board on which were mounted a sampling of industrial control devices, a CAMAC crate containing modules which interfaced the devices to the dataway, two different computers which were connected to the crate at different times, and a collection of programs, written in FORTRAN, which provided logical connections among devices on the board. The demonstration was visited by most of the attendees at the workshop and provided useful insights into the application of standard hardware and software.

3

SERIAL CAMAC MODULE

by

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Received 29th October 1973

SUMMARY A CAMAC module, based on LSI MOS packages, has been developed for serial input/output transfers in synchronous or asynchronous mode.

A serial I/O module has been developed to meet the demands of various communication problems. It is a computer-independent interface between serial links and the CAMAC Dataway. The unit is capable of transfers in full duplex mode. It can be used for anything from a simple TTY and display interface up to the construction of a slow to medium-speed communication network, which could use modems (Fig. 1). Such a system benefits from the modularity of CAMAC. The computer should not only control the modules but also get information about the status of the links. Therefore the module is capable of controlling the links via a CCITT V24 port.

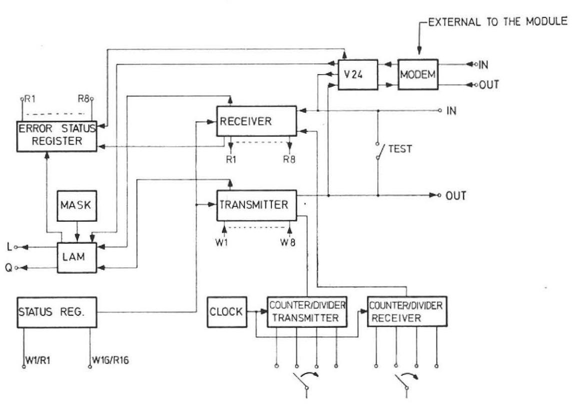

Fig. 1 Block Diagram of the Serial Module

The serial communication is performed by two Motorola MOS-LSI chips. The transmitter is controlled by the status register. It can be switched to transmit 5 or 8 bits per character in synchronous or asynchronous mode, with or without even or odd parity, and with one or two stop bits. The byte to be transmitted is buffered in the chip if the shiftout register is not free (double buffering). The receiver, also controlled by the status register, is able to receive in asynchronous or synchronous mode, with synchronisation by hardware. Error conditions are indicated by three status bits; Parity, Overrun and Break. Double buffering of the received character is included in the chip.

The ports to the serial links are modular (built on a sub-board). There is a 20 mA TTY port, a balanced pair port, a TTL port and a V24 for modem connection.

The LSI chips do not allow direct use of the CAMAC strobe pulse. Therefore timing circuitry on the board is necessary to expand the strobe pulses to 1 μsec.

The two different LAMs can be separately disabled, enabled and tested using the LAM mechanism proposed in CAMAC Bulletin No. 6 supplement p. 9, Fig. K5.4, 1a-2. A LAM status word can be read to implement a fast error search.

The information for the V24 port is stored and controlled by the general status register. In addition, a time-out for certain modem states is implemented. The frequency of the oscillator is set to 4•9152 MHz so that the standard baud rates are obtained by subdivision using binary counters.

The test software is written in BASIC for functional tests and in MACRO assembler for fast tests. Blocks of data are transferred between two memory buffers via a maintenance switch inside the module (software controlled) or a cable link at the front panel. After serial transfer at rates from 50 baud to 19·2 k baud, the buffer contents are compared. Initial testing revealed an error in the transmitter chip which was subsequently acknowledged by the vendor.

A simpler, asynchronous-only module is currently under development in cooperation with HMI Berlin. This design is based on the Universal Asynchronous Receiver/Transmitter (UART) chip, type 6011 from Texas Instruments. This chip, available under different numbers from several manufacturers, has become a de facto standard for asynchronous communications interfacing.

To support the module, a PDP-11 DOS driver is currently being developed for use in a planned slow communications system within KFA Jülich.

NEWS

CAMAC SPECIFICATIONS IN RUSSIAN

Specifications EUR 4100 and EUR 4600 have been translated into Russian by V. I. Vinogradov *et al.* of the Academy of Sciences of the USSR. Both texts are combined into one cover and refer to the English reference documents EUR 4100e and EUR 4600e of the ESONE Committee. The booklet also contains a short introduction, an abbreviated bibliography and illustrations of sample CAMAC hardware units.

NEWS

CAMAC SYMPOSIUM IN LUXEMBOURG

The first International Symposium on 'CAMAC in Real-Time Computer Applications' was held in the New Theatre of Luxembourg from December 4-6, 1973. The Symposium, arranged by the Commission of the European Communities in collaboration with the ESONE Committee, had three sessions devoted to the principal topics of CAMAC in laboratory automation, in industrial data acquisition and process control, and in the medical and health services. These sessions were preceded by two sessions of a tutorial type. The first one was an introduction to the CAMAC system with status reports about CAMAC applications in different parts of the world. The second dealt especially with CAMAC software.

Among the opening speeches, Mr. Christopher Layton outlined the Commission's proposals to pool resources in the field of data processing and computing. These proposals included co-ordination of policy in the field of standards and therefore the aims of the Symposium to introduce the CAMAC Standard into wider areas of application were directly in line with the Commission's proposal. CAMAC also fitted very closely into the Commission's second objective which is to make markets for equipment as open and as transparent as possible and finally, CAMAC was also related to its third objective to give manufacturers the possibility of achieving higher productivity through economies of scale.

Each of the three main technical sessions started with a review paper. R. K. Webster of Harwell gave a paper 'Automation of Laboratory Instruments —A Review', K. G. Hilton of GEC-Elliott gave the review paper in the Industrial Data Acquisition and Process Control session and A. J. Porth of Medizinische Hochschule, Hannover gave the paper on 'Prozessdatenverarbeitung in der Medizin'. In each session the review papers were followed by many papers on applications and by a discussion on questions arising from the papers and also the topic in general.

The overall impression created by the Symposium was that CAMAC is becoming well accepted in all kinds of research laboratories and also beginning to enter the industrial and medical worlds. In the industrial areas some apprehension was expressed because of the complexity of the CAMAC standard and some of its design features which were not compatible with an industrial environment. This was to a great extent discounted by W. T. Lyon from the Aluminium Company of America in a paper 'An Evaluation of CAMAC Equipment in an Industrial Environment'.

During the three-day Symposium, 55 papers were presented and more than 500 participants from 24 countries registered. The Symposium was supported by a considerable exhibition of CAMAC hardware parts and complete CAMAC systems, the exhibition being provided in the foyer of the theatre by 23 supply companies from Western and Eastern Europe and America. The joint programme of the technical sessions and the exhibition created a highly technical environment which was appreciated by the wide spectrum of participants and this contributed considerably to the success of the Symposium.

The Proceedings will be available in the Spring of 1974 from the Commission of European Communities, DG XIII, 29, rue Aldringen, Luxembourg. They will be distributed also to all subscribers of the CAMAC Bulletin as a supplement to CAMAC Bulletin No. 9 (see also, p. 24 of this issue).

BULLETIN ANNOUNCEMENTS

PREPARATION OF CONTRIBUTIONS

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

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

4

A CAMAC SERIAL BRANCH ADAPTER

by

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Institute for Nuclear Physics Research, Amsterdam, the Netherlands
and * Central Research Institute for Physics, Budapest, Hungary

Received 29th October 1973

SUMMARY The Serial Branch Adapter is a branch driver with interfaces to the CAMAC parallel Branch Highway and a serial highway. It allows seven crates, with controllers Type A, to operate as a remote sub-system via the serial highway, which is based on an interim proposal for the CAMAC serial system.

INTRODUCTION

The new 300 MeV Linear Electron Accelerator at IKO will have about 20 control and measuring stations, distributed over a distance of about 500 m. At the stations the equipment used will be mainly CAMAC. Over such distances cable and coupler element costs become very high. Therefore a bit-serial CAMAC transfer system will be used for those stations where the application of a small satellite computer is not necessary.

A Serial Branch Adapter (SBA) has been designed as the first unit of this serial CAMAC system. The SBA acts as a peripheral device connected at one side to the serial loop (Fig. 1) (one signal and one clock line) and at the other side to a normal CAMAC branch, specified in the EUR 4600 document.

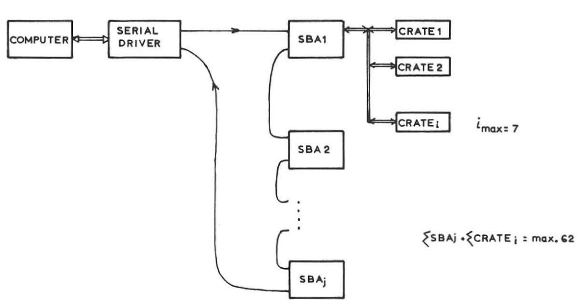


Fig. 1 Serial loop

The serial input and output signals are in agreement with a NIM/ESONE Working Group proposal ([1]), differing in some respects from the later Description of the Organization of Multi-Crate Serial CAMAC Systems ([2]).

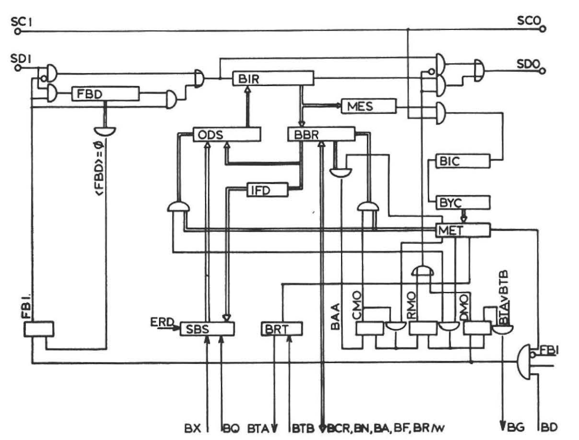
MESSAGE FORMATS

The control of the SBAs, and the data transfer to and from them, is provided by messages. An addressed SBA receiving a Command Message from the Serial Driver replaces the 'one' (idle) bytes following the Command Message by the Reply Message. The length of a Command and a Reply Message is in the case of data transfer always 12 bytes.

A Demand Message is generated by an SBA in consequence of a demand from the Branch Highway. The Demand Message is always 4 bytes long. The Demand Message is always 4 bytes long. The LAM Pattern field of the Demand Message contains the five least significant bits of the 24-bit Graded-L Pattern of the Crate Controller. The five-bit pattern can be used as an address field or as a priority code.

FUNCTION

Fig. 2 shows the block diagram of the unit. The serial incoming data are shifted into the Bit Register (BIR) directly or through a four byte delay, according to the status of FBI. When a start bit is received after more than 8 zero bits the Message Synchronization initiates a message start. If the SBA is addressed, the Branch Buffer Register (BBR)



SDI - Serial Data In
SDO - Serial Data Out
SCI - Serial Clock In
SCO - Serial Clock Out
FBI - Four Byte Delay In
ERD - Error Detected
BAA - Branch Adapter Addressed
BIR - Bit Register
BBR - Branch Buffer Register
ODS - Output Data Selector
FBD - Four Byte Delay
MES - Message Synchronization
BIC - Bit Clock
BYC - Byte Clock
NET - Message Timing
RMO - Reply Message On
DMO - Demand Message On
SBS - Serial Branch Adapter Status Register
BRT - Branch Timing
IFD - Internal Function Decoder

Fig. 2 Block Diagram of the Serial Branch Adapter

is overwritten by the incoming information after each received byte (Command Message). The first byte of the Command Message is retransmitted by the unit without any modification, but the other bytes of the message are replaced by zero bytes.

After receiving the complete Command Message, the branch timing section initiates a CAMAC handshake operation except when a message error has been detected or the SBA itself has been addressed. At the same time the message timing section sets the first byte of the Reply Message into the BIR through the output data selector. After the parallel to serial conversion of the first byte, the next byte

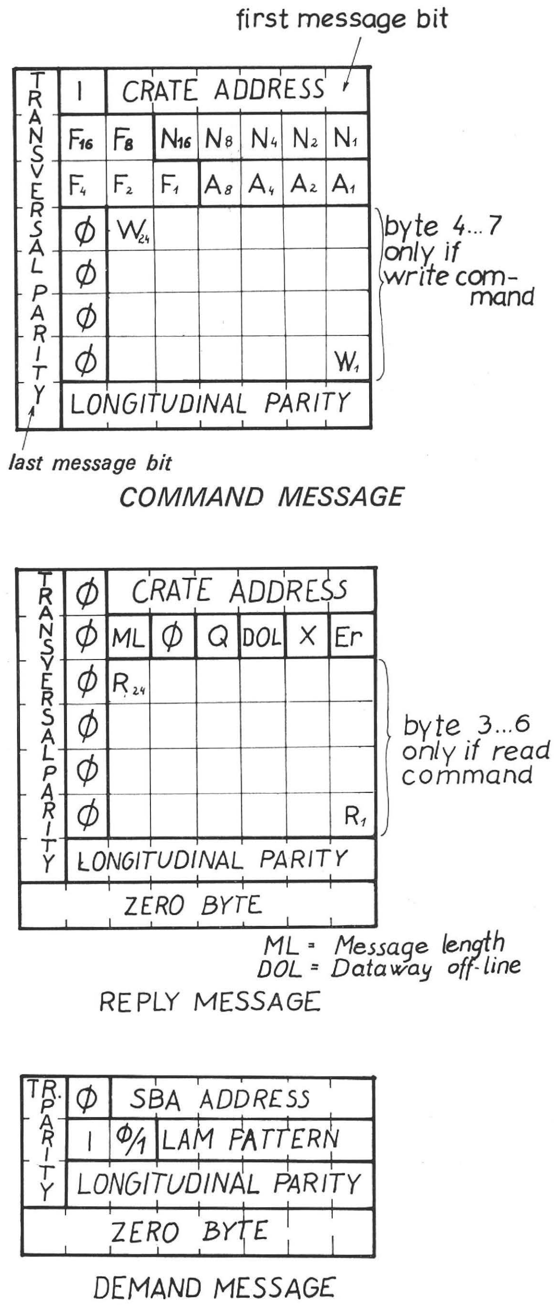


Fig. 3 Message formats

follows, etc. The Reply Message is closed by a zero byte.

A Branch Demand can be generated if demands have been enabled, the four byte delay is in off-position, and the content of the BIR is zero.

TIMING

The SBA operates in bit-serial mode. The maximum clock frequency is 4 Mbit/s. The SBA does not need any additional delay between messages. Each byte contains a start and a stop bit. The message synchronization is provided by the zero bytes after each Reply or Demand Message.

MECHANICAL CONSIDERATIONS

The SBA is an independent 19-inch wide unit, with one circuit board containing about 150 IC s. The branch highway connector and the connectors for the serial in- and outputs are mounted on the front panel of the unit. A connector for Inhibit, push-button for Initialise and an indicator for ON-LINE/OFF-LINE STATUS are also mounted on the front panel.

REFERENCES

1. Revised Proposal for Organization of Multi-Crate Serial Systems. USAEC NIM Committee, NDWG 73-4, April 1973. (unpublished)
2. CAMAC Serial System Organization — A Description. USAEC NIM Committee, TID 26 488 ESONE Committee ESONE/SH/01. December 1973.

ESONE ANNOUNCEMENTS

ESONE COMMITTEE ANNUAL GENERAL ASSEMBLY AND CAMAC EXHIBITION 1974

The assembly and exhibition will be held during the 18th-20th September 1974, in WARSAW, Poland. The assembly is being organised by:—

Instytut Badań Jadrowych
Pałac Kultury i Nauki,
00-901 Warszawa, Poland.
Contact: Dr. Roman Trechciński
Telephone No. 202297
Telex 813529 Atompl Warszawa

The exhibition is being organised by:—

Interatominstrument
00-791 Warszawa 36, Chocimska 28,
Poland.
Contact: Mrs. M. Wierzchoń.
Telephone No. 454304
Telex 814859 Atmin Warszawa

All further information, including registration and accommodation forms can be requested from the organisations listed above.

5

A MODULAR MICROCOMPUTER IN THE CAMAC SYSTEM

by

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Received 13th November 1973

SUMMARY Single-crate CAMAC systems can be operated by this modular microcomputer, constructed in CAMAC format and housed in the controlled crate. Several configurations are proposed, to cover tasks of differing complexity. The system can replace an external computer, and offers a significantly higher rate of CAMAC operations and lower cost.

INTRODUCTION

Many CAMAC systems do not need the large memory capacity and computing power provided by an associated computer. In a quite wide class of applications the main function of the computer is to generate a sequence of CAMAC commands. Most data acquisition systems involve rather limited processing of the accepted data. Simplified computers constructed in CAMAC standards [1,2,6] are successfully fulfilling the requirements of such applications. The solution presented in this paper offers a high speed of operation and full integration with the CAMAC system. It is not intended to compete with minicomputers in those fields where great computing power and complex software facilities are required. On the other hand, it makes the application of CAMAC a reasonable proposition in small systems, where users are often hesitant about the costs of CAMAC or non-CAMAC solutions.

MODULAR CONCEPT

Each configuration of the microcomputer described here consists of CAMAC modules plugged into a crate, with the CAMAC Dataway used as a unified bus system for all data and program transfers. Some non-standard interconnections between modules and the controller use patchpins P of the Dataway.

The CPU of the above system, an Autonomous Processor Type 130 which includes also the function of a crate controller, occupies the control station and two normal stations.

Any register in the CAMAC crate may be used as memory. Several types of memory modules have been developed for use with the Type 130 processor, namely:

- Read Only Memory (ROM) module type 220 or 221, of 32 words by 18 bits, for storing short permanent programs;
- A key-switch ROM type 231 consisting of a CAMAC module and two keyboards, each of 16 words by 18 bits. A typical application is as a short program store for module testing and program debugging;
- Random Access Memory (RAM) module type 210, of 16 words by 24 bits, for storing data or short programs, e.g. read in from paper tape;
- Eight bidirectional 24-bit counting registers (module 211) can be used for storing data in rather small systems;
- Ferrite core memory type 200 of 1024 words by 24 bits, a double-width module used in medium size systems;
- An interface for an external store. For example, the BM-96 4k memory unit (Intertechnique, France) has been interfaced and used in a particular application for storing both program and data;
- A 4k core memory (type 201) is in development.

Although the above modules were developed for the Type 130 processor they are general-purpose units and can be used in other systems.

Peripherals are connected via normal CAMAC modules.

Some examples of system configurations are given in Fig. 1. The simplest one (a) is a system with the switch-board memory and a single RAM module,

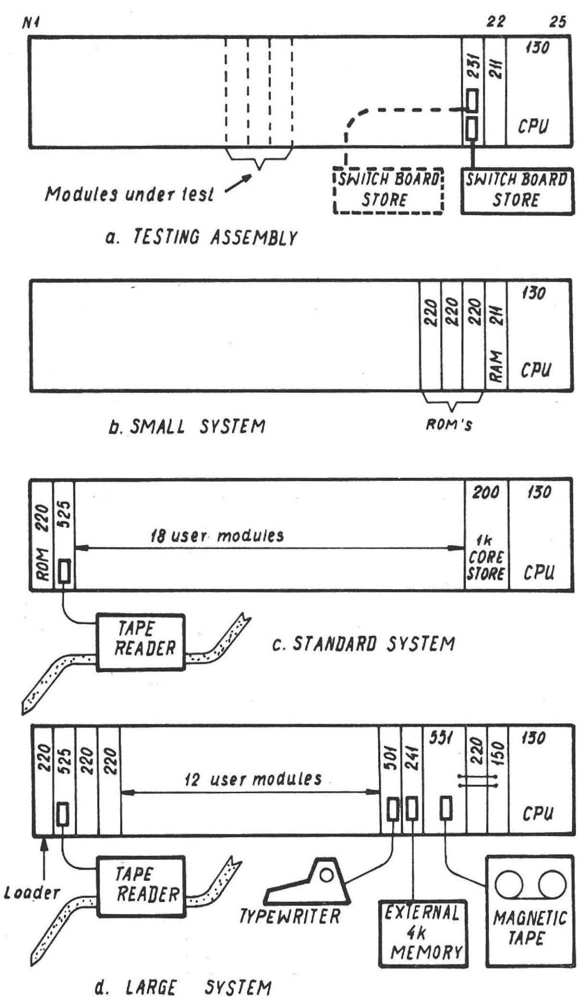

Fig. 1 Examples of System Configurations

and is used for testing the operation of a module or system.

Configuration (b) is a small system with a simple constant program stored in a few ROM modules. It uses one RAM module (210 or 211) for storing intermediate data.

Configuration (c), considered as a standard system, is equipped with one module of 1k store. The program is introduced via a tape reader. One ROM module is necessary to hold the loader program permanently. The remaining 18 stations are available for the user.

An example of a somewhat larger and complex system (d) is the case mentioned above, where fairly slow BM-96 memory (16 μs cycle-time) is used. Some ROM modules store program segments that must be executed quickly and a RAM module 210 is used for fast-access data storage. A special module (Type 150) organises the fast interrupt service necessary for the magnetic tape station.

ADDRESS FORMAT

Two types of addresses are used in the system:

- A 10-bit CAMAC-register address consists of 5-bit station-number N code, group bit F1 and 4-bit subaddress A;
- A 12-bit memory address applies to data stored in the 4k memory, it is limited to 10 bits when applied to program storage.

These two types of addresses are distinguished by bit M (M = 1 for core memory), which normally appears as bit 15 in registers and on the Dataway.

A processor instruction is a single word of 18 bits. It may contain a 10-bit or 12-bit address part or a 12-bit direct operand.

CPU — THE AUTONOMOUS PROCESSOR

The Type 130 unit combines the functions of a CAMAC single-crate controller and a processor executing commands fetched from memory modules. It includes 3 main registers: accumulator (AC), operation register (RO) and program counter (PC).

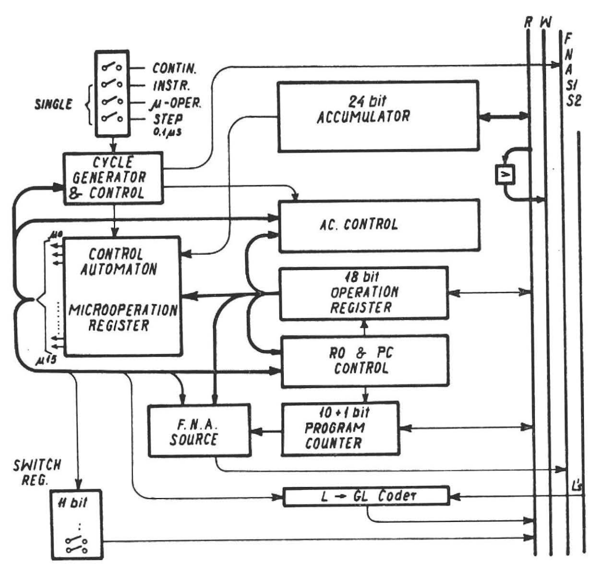

Fig. 2 Block Diagram of Processor

Data transfers between these registers use the read lines of the Dataway (see the block diagram of Fig. 2).

Every processor instruction is executed as a sequence of micro-operations and starts always from the micro-operation μ0. The central control circuit is a finite automaton with 16 states, which directly correspond to micro-operations μ0-μ15. Some of them generate CAMAC commands and Dataway operations.

Timing is controlled by a 10 MHz clock generator with a frequency divider, which also generates the Dataway strobe pulses S1, S2. Typical durations of the micro-operations are: 0.2, 0.6 and 1 microsecond. The resulting execution time of an instruction ranges from 1.8 to about 7.6 μs. For example, addition is performed in 2.2 μs if only CAMAC registers are involved. Indirect addressing costs 1 μs more. Each time a memory reference is made in the fetch, modify or execute phases of an instruction, 1 μs (typical) must be added. The cycle of a Dataway operation may be prolonged by a Hold signal[4] appearing on the bus-line P2.

The accumulator is a 24-bit register able to perform the following operations:

- load data from R-lines or send it to W-lines;
- logical AND, OR, arithmetic sum with the contents of R-lines;
- one's complement;
- left or right shift of upper and lower halves of AC together or separately.

Subtraction and twos complement need more than one micro-operation. Arithmetic is of twos complement type.

The operation register stores the 18-bit processor instruction. Its address part is subject to modification when indirect addressing is used. The five least-significant bits form a subtracting counter for counting steps in the shift or skip instructions.

The program counter contains a 10-bit scaler plus a one-bit PC(M) register indicating the type of memory actually involved. Ten bits of the instruction may refer either to one of 1024 locations of the ferrite core memory (M = 1), or to a CAMAC register (M = 0) addressed by N.F.A. The start address of the program has to be preset on a row of front panel switches. It is loaded into PC when the Initialise signal is produced manually.

The contents of PC, the micro-operation register, and either AC or RO (switched), as well as Q and X signals, are permanently displayed on the front panel.

Processor instructions

The list of instructions contains some conventional computer instructions as well as two special instructions, EX and LAM, inherently connected with the use of the CAMAC system.

The Execute (EX) instruction contains the FNA code of a CAMAC Dataway command to be fulfilled. In read or write commands the accumulator is involved in data transfer and indirect addressing may be used.

The EXM instruction acts with memory of up to 4k capacity. Five memory functions may be used: read, write, +1, —1 and reset-to-zero of an addressed location. The read and write operations need two Dataway operations for address and data transfer. Other operations need only one command F(17)· A(mf) for address and memory function (mf) transfer. Memory modules involved must respond to these commands.

The arithmetic instructions ADD and SUB (subtract) may use either a directly or indirectly addressed 24-bit operand.

Logical instructions AND and OR use only a directly addressed operand. The direct-operand instructions perform the above two logical operations, or addition with the 12-bit word contained in the instruction, or load such a word into the accumulator.

The jump instruction JMP and subroutine jump JMS may use indirect addressing. The return address is stored either in a specified external CAMAC register or at the zero-address memory location.

A special jump instruction is provided for L-signal searching. Its operation consists of 3 phases: first the GL-pattern (Graded L) is loaded into AC, possibly through a previously-stored mask; then the address part of the instruction replaces the contents of PC; finally left shift occurs in AC with simultaneous incrementing of the PC contents until the bit AC-24 becomes 1, i.e. when the Dataway L-signal has been found. The resulting PC-contents should be the entry point of a service routine for a module generating L.

Similar action occurs during Shift and Skip instruction (SSL or SSR). Any bit pattern existing in AC is processed in two phases: first preliminary left or right shifting is done; then simultaneous shifting in AC with incrementing in PC takes place. Such a combined shift and skip instruction, when applied to the LAM-request pattern read from a single module, allows further analysis of the previously identified Dataway L-signal.

Two other skip instructions allow for short conditional jumps in the program. The list of conditions contains the AC-overflow signal, previous Q-response, five accumulator bits: AC 1-4 and AC 24, as well as five manually set signals from the front panel switches P1-P5. The same conditions can be imposed on the Halt instruction.

In addition to the conventional shift operations, half-word shifts are possible. The 1's and 2's complements of AC complete the instruction list of the processor.

Most of these instructions include the conditional bit, and the appropriate tests are made either in the fetch or execute phases of the operation. They may result in skipping either the current or the next instruction. For example, the response Q = 1 from the addressed module will cause the instruction following the conditional EX instruction to be skipped.

Other features of the processor

Common Control signals Z, C and I may be generated by CAMAC commands as specified for the Crate Controller A (EUR 4600). Z and C signals may be also produced manually by front panel keys. Graded-L signals are produced in the processor unit from the Dataway L-signal by means of removable interconnections.

In addition to the normal continuous mode of operation, three types of step modes are provided: single-instruction, single-micro-operation and one clock-pulse, i.e. 1/10 of the Dataway cycle. Those modes are especially useful in module examination, both dynamic and static.

INTERRUPT MODULE

Any LAM request appearing on the Dataway must wait until it is recognized by program action. Requests requiring quick service may be processed in the interrupt mode organised by a separate, optional module (Type 150). It contains two registers for storing the contents of AC and PC at the breakpoint of the interrupted program. The necessary logic and program segment to accept 4 different interrupt requests of assigned priority is included. The addresses of entry points to four service subroutines must be prewired in the module.

FUTURE DEVELOPMENTS

Provision has been made in the processor unit for further extensions of the system in the following directions:

- Inclusion of another controller at a normal station in the crate, e.g. to enable direct access to memory from a selected module;
- Extension of memory capacity up to 16k, and of program addressing over 1024 locations;
- Organisation of multi-crate systems on the basis of the parallel branch (EUR 4600) or serial highway.

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6

A CAMAC MODULE FOR DC MOTOR CONTROL

by

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Received 13th November 1973

SUMMARY This module (Type 570) is used in conjunction with an external thyristor supply to control a separately-excited dc motor. Speed and direction of rotation are normally demanded via the Dataway, but external signal inputs are provided for manual control.

INTRODUCTION

When using this module to control a dc motor two external thyristor rectifier units are needed, one for the rotor and one for the stator supply. The power that can be controlled depends only on the thyristor rectifiers and not on the CAMAC module.

The direction of the motor may be reversed, and speed stabilisation is achieved by means of feedback. There are two methods of speed stabilisation and both may be used in this design. In the first method a feedback signal is taken from rotor.

This gives speed stability better than 5% over the full load range. The controlled speed ratio (n_{max}/n_{min}) is better than 50:1. In the second method the feedback signal is taken from a tachogenerator or tachopulser. This gives speed stability better than 2%, and the speed ratio reaches 100.

The module provides indications of READY to operate, OVERLOAD of motor, MANUAL control, and END (limit switch) states.

The limit switch located in the mechanical unit protects the mechanism against damage when its moving parts reach an extreme position. When the limit switch is actuated, rotation of the motor is only permitted in the safe direction. The motor is switched off when it is overloaded. Manual control has priority and gives similar facilities as automatic control, including status indication.

CIRCUIT DESCRIPTION

The block diagram of module 570 is shown in Fig. 1. The required speed and direction is written into the Data Register by means of F(16)·A(0). If the motor is READY to operate the module gives Q = 1. Speed information in binary code is accepted from Dataway lines W1-W7, and direction information from W8. The digital speed code is converted to an analog signal by a DAC and used in the rotor and excitation channels of the motor control.

In the rotor channel, the speed signal is applied to the rotor control amplifier, where it is compared with the feedback signal. The feedback signal depends directly on the voltage or speed of the rotor. An error signal applied to the phasing unit produces pulses for thyristor driving.

In the excitation channel, the speed signal is converted in a similar way as in the rotor channel and is used for the regulation of the excitation voltage. In this case the feedback signal is proportional to the excitation coil voltage. The analog speed signal may be shaped to achieve different modes of regulation for two motor speed ranges: a constant torque range, and a constant horsepower range.

To improve the mechanical characteristics at heavier loads and lower speeds there is the possibility of using positive current feedback (loop gain $\lambda < 1$). This feedback signal is taken from the rotor current, which depends on load torque. The same signal protects the motor against overloading. Overload protection starts to work when the current feedback signal exceeds a set level, and when this state lasts longer than a set time. In this condition the motor control is blocked and the OVERLOAD signal is generated. The blockage is removed when the speed is set to '0'.

From the demanded direction the Direction Control Unit generates the DIRECTION signal. In the same unit, the signal from limit switches, in conjunction with the demanded direction, generates the END signal, which is used for motor blocking.

The Synchronisation unit (SYNC) generates the

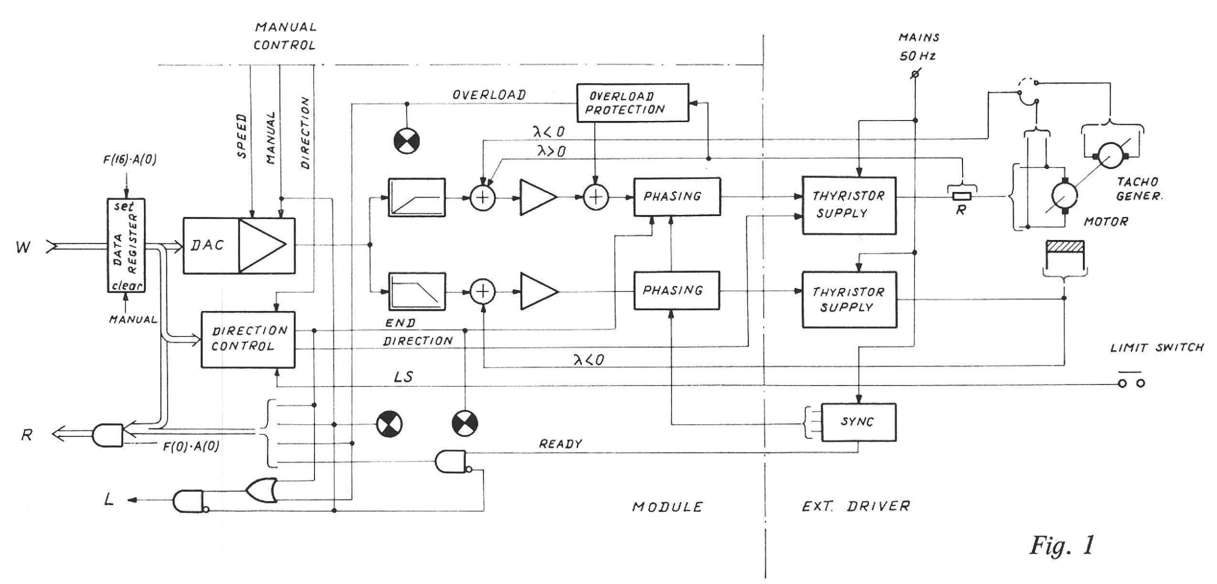

Fig. 1

necessary signals for driving the thyristor, and also the READY signal which shows that the motor can operate.

When manual control is selected, the MANUAL signal clears the Data Register and enables speed regulation by means of an external analog SPEED signal. This SPEED signal, in conjunction with the MANUAL signal, is applied to the DAC for motor control.

The signals OVERLOAD or END in the absence of the MANUAL signal generate the Dataway signal L. When the LAM request is tested with subaddress A(0) or A(1), the response is Q = 1 if the OVERLOAD or END signal, respectively, is present.

Information on module status is accessed at F(0)·A(0) and includes speed, direction, manual, ready and alarms.

Module 570 is used in a diffractometer for controlling the arm, sample table and goniometer motors.

BULLETIN ANNOUNCEMENTS

SOME STATISTICS ON CAMAC PRODUCTS

As an indication of the growth of CAMAC usage it would be useful to know the annual value or quantity of equipment sold by firms, or the number of stations occupied in systems. This data is not readily available, but it is possible to obtain some indirect evidence by analysing the contents of the Product Guide published in each issue of CAMAC Bulletin. The Product Guide merely shows that an item has been offered for sale by a firm, and does not indicate the volume of sales (some items are known to be selling briskly, while others are not yet in production). However, it is reasonable to assume that firms build up their range of products in response to their assessment of the size of the market—the more buoyant the market, the more new products are likely to appear.

In Fig. 1 the products listed in successive issues of CAMAC Bulletin are subdivided into the four main classification groups: Data Modules; System Control; Test Equipment; and Crates, Supplies etc. It will be seen that between November 1970 and October 1973 the total number of listed products increased from 340 to 1038. The number of Data Modules and System Control items, perhaps a better indication of actual functional units in CAMAC format, increased from 205 to 661.

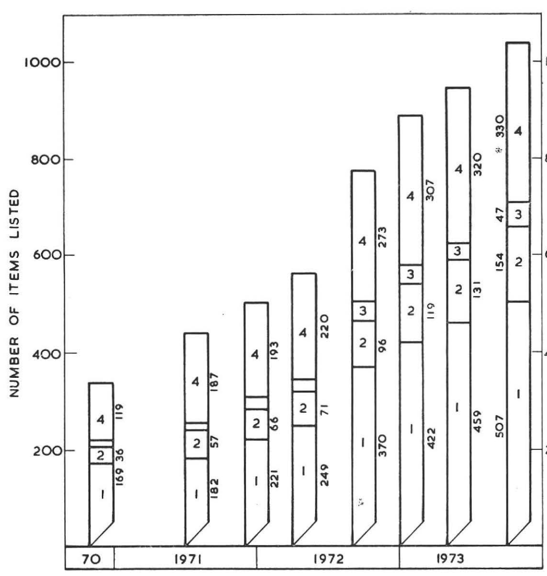

FIG. 1. BREAKDOWN OF CAMAC PRODUCTS BY CLASSIFICATION GROUPS

1. DATA MODULES 2. SYSTEM CONTROL
3. TEST EQUIPMENT 4. CRATES, SUPPLIES ETC.

In Fig. 2 the products in all classes are subdivided by area of origin (taking the addresses given for firms in CAMAC Bulletin No. 8).

A noticeable feature of this data is the sudden increase in products of all classes and origins in CAMAC Bulletin No. 5 (data collected in September 1972). This probably represents a second wave of products, influenced by the sales achievements and technical limitations of the earlier equipment. In particular, at this time firms began to offer several variants of each module (different word-lengths, external connections, etc.) in order to improve flexibility and coverage of the market.

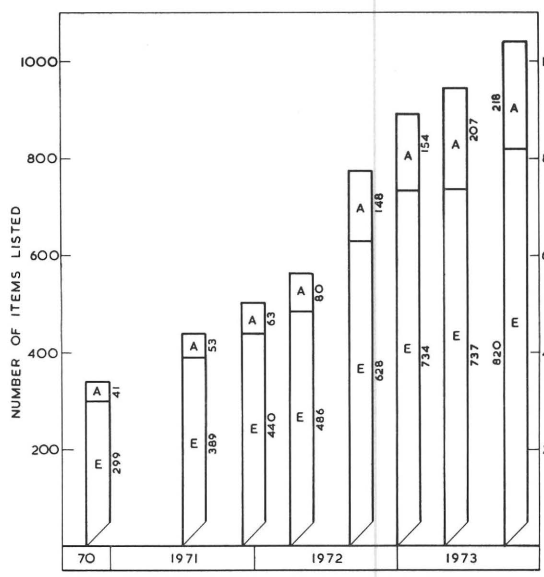

FIG. 2. BREAKDOWN OF CAMAC PRODUCTS BY ORIGIN

E. EUROPE (INCLUDING U.K.)
A. U.S.A. AND CANADA

Any differences between these figures and other published data derived from the same Product Guides (e.g. Bisby, Luxembourg, December 1973) are due mainly to the way composite items (e.g. families of units) have been counted, and to the use of the date of data collection rather than the date of publication of the Bulletin.

7

A FAST PATTERN UNIT WITH CAMAC READOUT

by

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Received 13th November 1973, revised 2nd December 1973

SUMMARY This CAMAC module accepts 16 fast input signals. After discrimination and shaping, the inputs are strobed by a coincidence signal (resolving time 5ns) into a buffer register, from which the pattern can be read via the CAMAC dataway.

INTRODUCTION

Pattern Units (PU) are devices which store the pattern of input signals from event-detectors in nuclear experiments. Those signals present at the time of a gating signal are strobed by nanosecond coincidence circuits into a register. The content of the register, which represents the event-pattern can be read by on-line computers via the CAMAC dataway.

DEVICE DESCRIPTION

Fig. 1 shows the block diagram of the 16-bit PU. The 16 channels are completely independent. Each input is terminated and applied to a fast and sensitive discriminator that has two outputs, one for the coincidence circuit, and another for counting the number of pulses which trigger the discriminator. The output pulses are shaped for standard amplitude (NIM) and variable pulse width. Pulses from the discriminator, which are in coincidence with the strobe pulse, are stored in a flip-flop, one for each channel, forming the event pattern register. The register is read and cleared by CAMAC-commands and has also a built-in manual reset.

Each channel flip-flop triggers a fast pulse shaper, so that an output signal of fixed width is generated. This can be used in time of flight experiments to stop the time digitizing. In some experiments there may be a simplification by wiring together the outputs of 4 channels to stop the Time-to-Digital Converter (TDC). Both facilities are built into this module.

Since the fast circuits are designed in ECL-technology, there has to be level-shifting to the CAMAC TTL-levels.

CIRCUIT DETAILS

Fast Logic

The inputs are terminated by 51Ω and protected against high-voltage pulses by fast hot-carrier diodes with a minority carrier lifetime of 100 psec max, and high reverse voltage of 70 V.

The 16 discriminators are constructed with the very fast (> 100 Megapulses per sec) analog-digital-com-

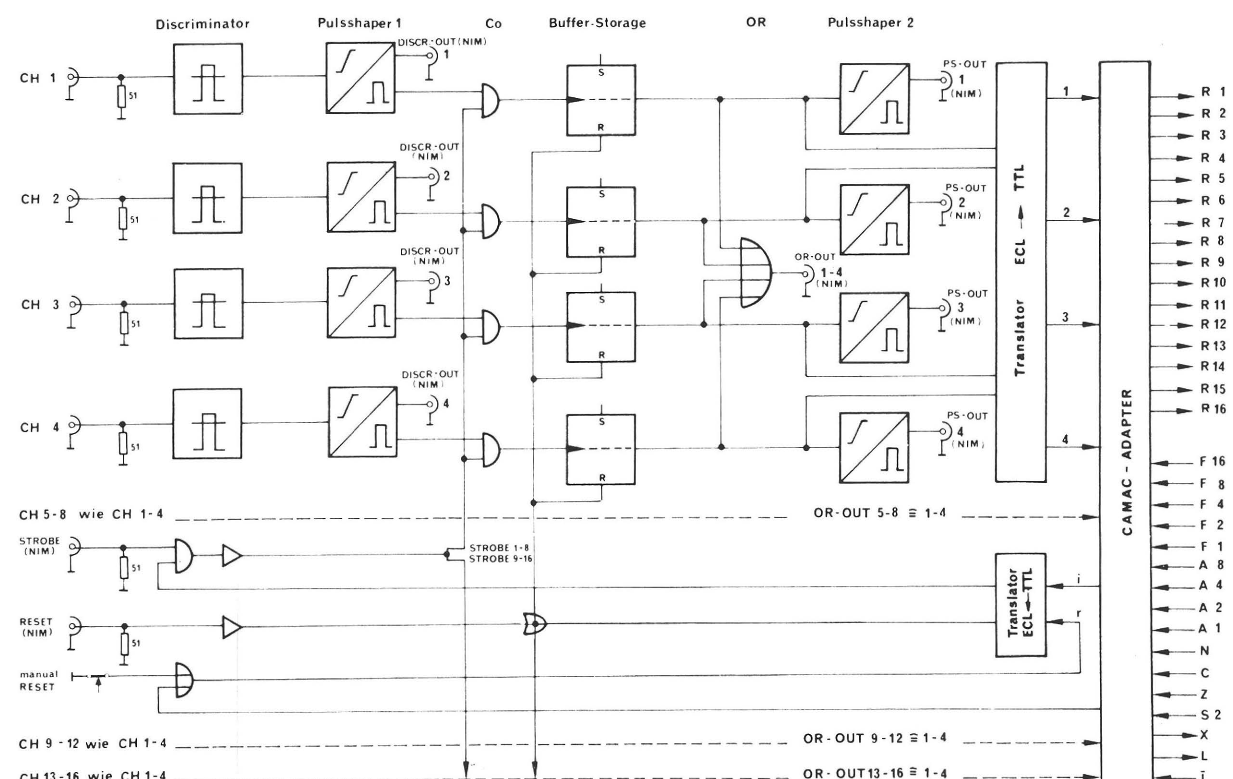

Fig. 1 Block Diagram of the 16-Channel-Discriminator-Coincidence-Buffer-Storage

parator MC1650L. The threshold in each channel is individually and continuously variable from −75 mV to −1.1 V by front-panel mounted potentiometers, and can be measured with a DVM at 16 check points. All 16 threshold circuits are driven from a special regulated power supply so that they have a stability of <0.25 mV/°C. There is no threshold-dependence for pulse widths greater than 5 nsec. The time-slewing is <1 nsec from 1.1 to 10× treshold.

The leading edge of the positive going pulse from the comparator triggers the pulse shaper PS1 by clocking a flip-flop in the one-shot mode. The width of the flip-flop Q-pulses can be varied individually from 5 to 50 nsec. The flip-flop Q-pulses are coupled through inverters to the NIM-output stage, which is a differential amplifier and delivers negative pulses of 18 mA into 50 Ω.

The coincidence and buffer stages are combined in D-type flip-flops with fast gate inputs. They are driven by two inputs, one from the PS1, the other from the strobe line. Only those positive-going leading edge of the PS1-pulses, which are in coincidence with the strobe signal on the D-inputs, are able to clock the flip-flops and store the channel information.

Four groups of 4 channels (CH1-4, CH5-8, CH9-12, CH13-16) are OR'ed together, and the output is connected to an emitter-coupled pair, which delivers standard NIM-signals of 18 mA in 50 Ω. The OR-outputs are DC-coupled, so the pulse width is equal to the time between set and reset of the storage flip-flops.

The $\bar{Q}$-output of each storage flip-flop is connected to an ECL→TTL translator, which generates a negative pulse level for the CAMAC interface.

The Q-output of each storage flip-flop triggers a pulse shaper PS2 with its positive going edges. In its function, PS2 is similar to PS1, and generates pulses of 8 nsec width (with fixed time constant) which are coupled to complementary transistor stages, delivering NIM-pulses of 18 mA into 50 Ω.

The strobe input receives NIM-signals with a minimum width of 5 nsec, and rise and fall times of 1.5 nsec. The coincidence resolving time is approximately the strobe pulse width plus 0.5 nsec. Most of the delay between signals in channels 1-16 and the strobe signal has been compensated by the layout of the printed circuits, so that channel signals need precede the strobe by only 2 nsec. The strobe signal drives 16 coincidence inputs through inverter gates, which are cut off by the CAMAC command N·A(0)·F(2) + I. This means that the gates are closed by the CAMAC Inhibit signal or by readout of the storage register.

$$N \cdot A(0) \cdot F(2)$$

There are 3 reset facilities:

- reset with standard NIM pulse;
- CAMAC controlled reset with (N·A(0)·F(2) + C + Z)·S2;
- manual reset by push-button on the front panel.

CAMAC Adapter

Fig. 2 shows the block diagram of the CAMAC Adapter. The 16 data lines, which represent the $\bar{Q}$-outputs of the storage flip-flops, are gated with the CAMAC command N·A(0)·F(2) onto the R1-16 lines of the CAMAC Dataway.

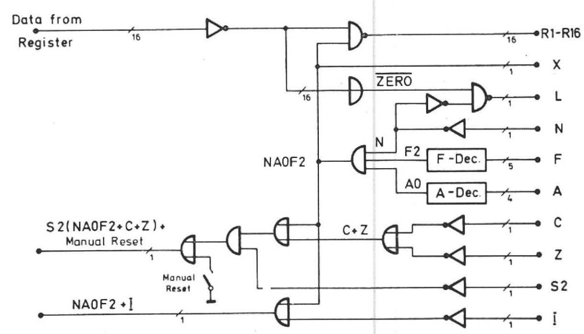

Fig. 2 CAMAC-Readout

The data lines are also NOR'ed to give a NON-ZERO signal if any of the flip-flops is set. This signal is gated with N to generate the Dataway L signal. If the CAMAC Adapter receives the F(2) function (the only function used in this version), with N and A(0), it gives the X response. The reset of the register after readout clears the LAM request automatically.

The Inhibit signal I is OR'ed with N·A(0)·F(2) to generate an internal Disable signal. The C and Z lines are used in conjunction with the strobe signal S2 to reset the register, and the manual reset also resets it.

BULLETIN ANNOUNCEMENTS

PROCEEDINGS OF CAMAC SYMPOSIUM

All Bulletin subscribers will receive with this Issue, a copy of the Proceedings of the 1st International Symposium on CAMAC in Real-Time Computer Applications, Luxembourg, Dec. 4-6, 1973, as a Supplement.

Non-subscribers of the Bulletin who have ordered their copy of the Proceedings during the Symposium will receive it at the special subscription price for participants.

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IDEAS AND TECHNIQUES

PROPOSED CLASSIFICATION OF SOFTWARE FOR CAMAC

by

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Received 13th November 1973; revised 10th January 1974

SUMMARY This proposed classification of CAMAC Software is an extension of the scheme used for the CAMAC Hardware Product Guide. An example of a CAMAC Software Guide illustrates the use of this classification.

A form summarising the Data needed for the exchange of Software documentation is included.

INTRODUCTION

The need for some organized way of presenting existing CAMAC Software to users has been recognized for some time, but the information failed to materialize for various reasons. Availability of suitable documentation for programs, routines etc, is important for the users. We feel that a reasonable classification scheme will be of great help for the maintenance of programs and a step towards standard Software.

The practical approach to CAMAC Software classification presented in this article follows the general scheme tentatively applied for the CAMAC Products Guide, and described in a previous article in this journal (1). The proposal is not intended to represent the views on the matter of the ESONE Committee or any of its bodies. The various aspects of CAMAC Software classification have been considered from the point of view of CAMAC designer, programmer, engineer-operator, phycisist-user and systems man.

The merits of a classification scheme are best demonstrated by a practical example. We have therefore included a sample of CAMAC Software Guide. A skeleton form summarizing characteristics and other data related to Software is included for the benefit of prospective CAMAC Software writers.

CLASSIFICATION PRINCIPLES

The proposed classification of CAMAC Software is an extension of the decimal classification system tentatively used for CAMAC Hardware. We repeat here the basic classification principles.

. Related subjects are arranged systematically into classes.

. Proceeding from the general to the more particular, items or topics are divided into classes and further into subclasses to the required degree.

. Main classes are denoted by the most significant decimal fraction, subclasses by less significant fractions,

and the main classes, now including Software, are:

.0 Generalities, methods, applications, documentation,
.1 Data modules,
.2 System control,
.3 Test equipment,
.4 Crates, supplies, accessories,
.5 Software.

STRUCTURE NOTATION

The structural break-down of CAMAC Software cannot be done with the same ease and exclusiveness as for CAMAC Hardware. Much Software for general applications also find uses in CAMAC applications. The major part of specific CAMAC Software will, most probably, be programs and routines for on-line CAMAC applications. But it is fully conceivable to have compilers, assemblers, debuggers etc., operating off-line and to have on-line I/O routines and other service programs written for CAMAC. CAMAC languages have also been proposed. So classes must be defined for all such types of Software.

For Software we have the option to use one or more main classes, as is the case for Hardware. But we will resist the temptation and use only one class, namely .5, as shown above.

The break-down into subclasses proceeds from the general to the particular, by building up the decimal code, thus:

.5 Software,
.54 Support Software I,
.543 Compilers,

The break-down into lower-level classes beyond three digits presents no great difficulties, but we stop there for practical reasons.

DEFINITION OF CLASSES, CRITERIA

We have chosen criteria for the definition of second level classes which are loosely analogous to primary Hardware class criteria, i.e. user-oriented, system-oriented, and so on. These also agree fairly well with the general organization of computer software in users' runtime and system service programs. Other possible classification criteria which have been considered for this level are programming languages,

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** Institute of Physics, University of Warsaw, on Leave to CERN, Geneva.
*** CERN Geneva, Switzerland.

computer Hardware configurations, and users applications, but these were discarded for various reasons.

Third level criteria define type of program, for instance .541 – assemblers, .543 – compilers. For users' programs and routines the third level is not denoted by the extension of the decimal fraction. Instead the language name is added within brackets, e.g. .52 (FORTRAN).

Languages, algorithms, and general CAMAC Software information are grouped in a class for general subjects.

Appendix A shows the outline of all classes and, for Software, also the subclasses.

CONCLUSION

Well written and proven Software is essential for the efficient use of CAMAC systems and the realisation of their inherent potential, and may be a decisive factor for prospective users in their choice of a computer system. Publication of programs for CAMAC applications, CAMAC languages, the establishment of a users society, etc., are some of the possible means to develop Software for CAMAC and support its growth. A classification system, such as the one proposed, has its natural role in such activities.

(1) Nicolaysen, O. Ph. Decimal classification of CAMAC instrumentation. *CAMAC Bulletin* No. 7, July 1973.

Appendix A

Outline of the main classes, and Software subclasses

.0	Generalities, Methods, Applications, Documentation.
.1	Data Modules (I/O Transfers and Processing).
.2	System Control (Computer Couplers, Controllers and Related Equipment).
.3	Test Equipment.
.4	Crates, Supplies, Components, Accessories.
.5	Software.
.50	Fundamental Concepts, General Subjects.
.500	General Descriptions, Documentation, etc.
.501	Languages.
.502	Algorithms.
.51	User-Oriented Programs I (full system support with user run-time and CAMAC system service programs).
.52	User-Oriented Programs II (specific run-time programs).
.53	User-Oriented Programs III (subprograms, routines, Hardware programs).
.54	Support Software I (translators).
.541	Assemblers (with/without macros).
.542	Cross-Assemblers.
.543	Compilers.
.544	Interpreters.
.55	Support Software II.
.551	Loaders.
.552	Linking Programs.
.553	Utility Routines.
.57	Other Service Programs.
.571	Editors.
.572	Debugging Routines.
.573	Test Routines.

Appendix B

CAMAC Software documentation form

Title (article, system, program, etc.) . . . .
. . . .
Publ. ref. . . . .
Author(s) . . . .
. . . .
Type of Software (system, progr. subprog., I/O routines, interpreter, editing, etc.) . . . .
. . . .
Progr. language used . . . .
CAMAC Software environment (host language or non-CAMAC basis) . . . .
. . . .
Technique of incorporation of CAMAC feature (embedded, overlay, etc.). . . . .
. . . .
Summary of facilities (symbolic device name, single/multiple action/instruction, demand handling, etc.) .
. . . .
Available in form (cards, tape, algorithm, etc., state No. of cards, tapes and codes) . . . .
. . . .

Class code . . . .
Name (acronym) . . . .
Version . . . .
Operative date . . . .
Esone regstr. date . . . .
Progr. maintenance (name). . . . .
. . . .
Program obtainable from . . . .
. . . .
. . . .
. . . .
Computer used . . . .
CAMAC interface type used . . . .
. . . .
Core requirements . . . *words* . . . *bits/word* . .
Min system requirements . . . .
. . . .
. . . .

Description (features, characteristics)

APPENDIX C

SAMPLE CAMAC SOFTWARE PRODUCTS GUIDE

.50 FUNDAMENTAL CONCEPTS, GENERAL SUBJECTS

TITLE-- CAMAC FACILITIES IN THE PROGRAMMING LANGUAGE OF PL-11
AUTHOR-- ROBERT D RUSSELL, CERN, GENEVA
PUBL.REF-- PROC CAMAC SYMPOSIUM,LUXEMBOURG, DEC 1973
SOFTWARE TYPE-- LANGUAGE, PL-11(EXTENDED)
TECHNIQUE OF INCORPORATING CAMAC FEATURE--
IN-LINE CODING OF CAMAC STATEMENTS
FACILITIES-- SYMBOLIC DEVICE NAME USED, DEMAND HANDLING INCLUDED

CLASS-- .501(PL-11)
NAME-- EXTENDED PL-11
OPERATIVE DATE-- 1971/72
COMPUTER-- PDP-11
CAMAC INTERFACE USED-- CA 11
WORDS ARE 16 BITS LONG

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

.51 USER-ORIENTED PROGRAMS I (FULL SYSTEM SUPPORT)

TITLE-- TRIUMF CONTROL SYSTEM SOFTWARE
AUTHORS-- D P GUARD, W K DAWSON,
TRIUMF, UNIVERSITY OF ALBERTA, CANADA
PUBL REF-- CAMAC BULLETIN NO 5, NOV 1972
TYPE OF SOFTWARE-- COMPLETE SYSTEM SUPPORT
FOR CONTROL OF TRIUMF CYCLOTRON

CLASS-- .51
ACRONYM--
OPERATIVE DATE-- 1973
COMPUTERS-- 4 SUPERNOVAS
INTERFACE-- IN-HOUSE TYPE

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

.53 USER-ORIENTED PROGRAMS III (SUBPROGRAMS, ETC)

TITLE-- CAMAC AND INTERACTING PROGRAMMING
AUTHOR-- DR E M RIMMER
PUBL.REF-- PROC CAMAC SYMPOSIUM,LUXEMBOURG, DEC 1973, & BASIC CALLABLE ROUTINES, NP GROUP NOTE NP-DHG, RIMMER
SOFTWARE TYPE-- SET OF SUBROUTINES
PROGR LANGUAGE USED-- HP ASSEMBLY
HOST LANGUAGE-- BASIC (HP EXTENTION OF)
HOST LANGUAGE-- BASIC (HP EXTENTION OF)
CAMAC FEATURE INCORPORATED-- IN-LINE CODED CALLS IN BASIC, SUBROUTINES IN ASSEMBLY, ABSOLUTE ADDRESS
FACILITIES-- SINGLE & MULTIPLE ACTION/INSTRUCTION, NO DEMAND HANDLING
AVAILABLE IN FORM-- PAPER TAPE, ASCII CODE

CLASS-- .53(BASIC)
ACRONYM-- HPCMA,HPCMB,HPCMC
OPERATIVE DATE-- 1971/72
PROGRAM OBTAINABLE FROM--
NP-DIV, CERN, CH-1211 GENEVA
COMPUTER USED-- H-P 2100-SERIES
CAMAC INTERFACE USED-- BORER TYPE 2201, CERN TYPES 7218 & HPCC-066
CORE REQUIREMENTS-- 8K OF 16 BIT WORDS
MIN SYSTEM REQUIREMENTS-- TELETYPE OR OR TEKTRONIX 4010 TERMINAL & CC A1

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

TITLE-- SPECIFICATIONS FOR STANDARD CAMAC SUBROUTINES
AUTHOR-- RICHARD F THOMAS, JR
PUBL.REF-- CAMAC BULLETIN NO 6, MARCH 1973
TYPE OF SOFTWARE-- SET OF SUBROUTINES
PROGRAMMING LANGUAGE USED-- FORTRAN
CAMAC FACILITIES-- BASIC CAMAC OPERATIONS, STANDARD BLOCK TRANSFERS IN SINGLE AND MULTIPLE ACTION STATEMENTS
AVAILABLE AS-- ALGORITHM

CLASS-- .53(FORTRAN)
ACRONYM-- SEE DESCRIPTION
OPERATIVE DATE-- 1973
PROGRAM OBTAINABLE FROM--
USAEC NIM COMMITTEE, CAMAC SOFTWARE WG
COMPUTER-- INDEPENDENT
CAMAC INTERFACE-- ANY
CORE REQUIREMENTS-- NOT SPECIFIED

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

,54 SUPPORT SOFTWARE I (TRANSLATORS)

```
TITLE-- A CAMAC EXTENDED BASIC LANGUAGE                                  CLASS-- ,544(BASIC)
AUTHOR-- J M SERVENT (SCHLUMBERGER),FRANCE                               ACRONYM-- CASIC
PUBL,REF-- PROC CAMAC SYMPOSIUM,LUXEMBOURG, DECEMBER 1973                OPERATIVE DATE-- 1973
TYPE OF SOFTWARE-- INTERPRETIVE LANGUAGE EXTENDED WITH MACRO-            PROGRAM OBTAINABLE FROM--
INSTRUCTION GENERATOR                                                    SCHLUMBERGER/SAIP, BAGNEUX, FRANCE
LANGUAGE-- EXTENDED BASIC                                                COMPUTER-- PDP-11
TECHNIQUE OF INCORPORATING CAMAC FEATURE-- IN-LINE STATEMENTS            CAMAC INTERFACE USED-- ICP 11 & JCC 11
DESCRIPTION--        STANDARD BASIC IS EXTENDED WITH 4 NEW TYPES OF STATEMEMENTS AND 2 SPECIAL
                     REGISTERS, EXECUTION OF CAMAC STATEMENTS ARE SPEEDED UP ABOUT 10 TIMES COMPARED
                     WITH STANDARD BASIC,
                     TYPICAL STATEMENTS--
                     DECLARATIVE-- 100 LET $S8 = STA (2,4,N+3,A+2)
                     OPERATIONAL-- 130 R1 = CAM ($S8, READ )
                     CONDITIONAL-- 156 IF %QCAM = 0 THEN LET A = A+1
                     INTERRUPT/LAM-- 23 ON LAM %REG THEN GOTO 130
                     THE INTERRUPT WILL BE SERVICED ONLY WHEN PROGRAM HAS ADVANCED TO THE
                     LAM-HANDLING STATEMENT,


TITLE-- FOCAL OVERLAY FOR CAMAC DATA AND COMMAND HANDLING                CLASS-- ,544(FOCAL)
AUTHORS-- F MAY, H HALLING, K PETRECZEK                                  NAME-- FOCADAT
PUBL REF-- CAMAC BULLETIN NO 1, JUNE 1971                                OPERATIVE DATE-- 1970
TYPE OF SOFTWARE-- INTERPRETER (EXTENDED)                                COMPUTER USED-- PDP-8
CAMAC SOFTWARE ENVIRONMENT-- FOCAL                                       CAMAC INTERFACE USED--
TECHNIQUE OF INCORPORATION OF CAMAC FEATURE--CAMAC EXTENSION ON          IN-HOUSE CC & INTERFACE
OVERLAY, IN-LINE CODING OF CAMAC COMMANDS                                CORE REQUIREMENTS-- 4K & 8K 12 BITS/WORD
DESCRIPTION--        THE INTERPRETER IS PRIMARILY INTENDED FOR EASILY PROGRAMMED ON-LINE CAMAC
                     SYSTEMS IN NON-TIME-CRITICAL CONTROL AND DATA HANDLING APPLICATIONS AND FOR TEST
                     ROUTINES,
                     THERE ARE 9 CAMAC STATEMENT TYPES COVERING GENERAL CONTROLS (Z, C, I) AND CAMAC
                     COMMANDS WITH/WITHOUT DATA TRANSFER,
                     THE GENERAL FORM OF A CAMAC STATEMENT IS --
                     +A CF,C,N,A,F,FB,HW [,LW,Q]
                     WHERE SEVERAL PARAMETERS MAY BE OMITTED,


TITLE--COMP11, A CAMAC-ORIENTED MONITOR FOR THE PDP-11                   CLASS-- ,544
AUTHOR-- RONALD M KEYSER (EG&G/ORTEC)                                    NAME-- COMP11
PUBL REF-- CAMAC BULLETIN NO 7, JULY 1973                                OPERATIVE DATE-- 1972
TYPE OF SOFTWARE-- INTERPRETER FOR CAMAC                                 PROGRAM OBTAINABLE FROM--
PROGRAMMING LANGUAGE USED-- PAL-11                                       EG&G/ORTEC, OAK RIDGE, TENNESSEE
                                                                         COMPUTER-- PDP-11, INTERFACE-- BD011
                                                                         CORE REQUIREMENTS-- 4K OF 16 BITS/WORD
DESCRIPTION--        COMP11 IS A STAND-ALONE PROGRAM WHICH ALLOWS USERS TO EXECUTE ANY CAMAC COMMAND,
                     INSTRUCTIONS, TYPED IN ON A TELETYPE, ARE EXECUTED IMMEDIATELY IF CHARACTER
                     STRING FORMS A VALID INSTRUCTION OR COMMAND,
                     A LEARN MODE IS INCORPORATED TO ALLOW FOR REPEATED EXECUTION OF A SERIES OF
                     CAMAC COMMANDS, COMMANDS TO BE LEARNT MAY BE ENTERED INTERMIXED WITH COMMANDS
                     EXECUTED IMMEDIATELY,
                     GENERAL FORM OF INSTRUCTION--
                     $P1/P2/P3/XX
                     EX- S0/10/0/IN (READ SCALER F(0)N(10)A(0) )
```

,55 SUPPORT SOFTWARE II

```
TITLE-- A FOCAL INTERRUPT HANDLER FOR CAMAC                              CLASS-- ,553(FOCAL/PAL)
AUTHORS-- F MAY, W MARSCHIK, H HALLING                                   NAME-- FOCALINT
PUBL REF-- CAMAC BULLETIN NO 6, MARCH 1973                               OPERATIVE DATE-- 1971
TYPE OF SOFTWARE-- INTERRUPT HANDLER (SYSTEM PROGRAM)                    COMPUTER USED-- PDP-8
DESCRIPTION--        FOCALINT IS A GENERAL PURPOSE SYSTEM PROGRAM, ADAPTABLE FOR SPECIAL USE , UP TO
                     3 CRATES WITH 24 INTERRUPTS EACH CAN BE SERVICED,  ONE PROGRAM LINE IN FOCAL IS
                     RESERVED FOR EACH INTERRUPT, SHORT ROUTINES CAN BE TYPED INTO THESE LINES
                     SERVICING THE ASSOCIATED INTERRUPTS, ALTERNATIVELY A FOCAL SUBROUTINE CAN BE
                     USED,  CURRENT LINE IN THE BACKGROUND PROGRAM WILL BE FINISHED BEFORE JUMPING TO
                     INTERRUPT ROUTINE AND RETORNS TO NEXT LINE IN THE BACKGROUND PROGRAM AFTER
                     SERVICING,
```

Remarks

This Sample Guide is included for illustrative purposes only and does not imply approval of listed Software by the ESONE Committee or anybody else nor disapproval of Software which is not listed.

It is the intention to publish a CAMAC Software Guide in future issues of this Bulletin. For this CAMAC Users' cooperation is needed and therefore everybody is kindly requested to send any contributions to:

O. Ph. Nicolaysen
CERN, NP Div.
CH–1211 Genève

INTERVIEWS

HAS CAMAC A CHANCE IN MEDICINE?

Interview conducted by H.-J. Stuckenberg, Hamburg, Germany, against the background of the Luxembourg Symposium

Question: At this symposium, I have heard a lot about applications of medical electronics. Do you believe that the use of electronics in medicine has been a success so far?

Answer: Well, there are special branches in medicine where electronic devices are applied, for example: nuclear medicine, treatment and control in intensive-care units, as well as acquisition and preprocessing of clinical data. The degree of success varies. Designers of medical electronic devices quite often forget to take into consideration the unusual conditions in a hospital. Hospitals are not quiet sanatoriums for almost healthy patients, but they are clinics where the staff are always in a hurry to save lives.

Electronic devices which have a sophisticated front panel with lots of knobs and switches may be of great interest electronically but are not useful in medicine. Such devices are as poorly user-engineered as devices whose fuse cannot be found in an emergency, or equipment which has impractical rules of use for doctors or nurses who are not familiar with electronics and have no time to learn it. Electronic equipment having connectors which can be interchanged by mistake is very dangerous, especially in an intensive care unit where the condition of a patient is highly unstable when breathing or heartbeat stops. So we can see that the survival chances of patients may be impaired by such mistakes due to poorly-designed components. But we also have in use a lot of good devices which have already been very successful in the harsh environment of the hospital. We hope that we shall get even better and more useful equipment in the future, especially since the use of electronics in medicine is increasing rapidly.

Question: Can you tell us what kind of requirements are needed in new electronic systems for medical use?

Answer: Oh yes, we have some minimum requirements:

- electronic equipment must be ruggedized so that it can withstand all critical hospital conditions, perhaps it should be mounted in a sealed case,
- it must be able to be brought into action in a hurry, because in emergencies doctors and nurses are very busy people,
- its operation should be simple and require no special pretraining,
- the components of an electronic system should be connected in a standardized matter.

Question: What do you understand by standardization?

Answer: Standardization means that you should have

- compatible connectors and mechanical dimensions of the devices, for instance for the plug in-units and the chassis,
- standardized signal levels at the 1/0-circuitry of the equipment to interconnect these units without risk of damage,
- standardized interfaces for computer-connected devices.

Question: CAMAC is a standardized interface system widely used in many countries. In the CAMAC system there are precisely described interfaces between the devices and their controller, and between the controller and computer. But not only the signal paths are fixed, the levels of analog as well as digital signals are defined. Would such a system meet your requirements?

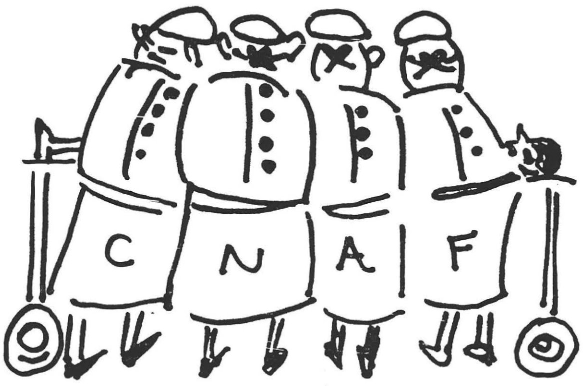
Answer: Well, I think CAMAC is a system for connecting electronic devices to the computer. Before I give an answer to your question, whether CAMAC is a good system which can be introduced in medical electronics, I should mention that we have some very simple applications of electronic equipment, where it would be expensive and inappropriate to use a computer. These devices are often designed for one particular job but we would still like to have standardized rules, for instance to connect the outputs to recorders. I am sorry to say that 100 of such devices have 150 different rules, some need 10 mA to drive 100 Ohm-recorders, some drive 100 µA in 10 k Ohms and some could not drive any available recorder.

But if you use an electronic system that is connected to a computer, an interface system like CAMAC would be a very good choice because, as far as I know, it is the only one which has been introduced internationally and is produced by more than 40 companies.

Question: Can you say something about the kind of medical applications where a computer is very useful today?

Answer: Oh, there are many applications, for example:

- simultaneous supervision of many patients by a minimum of nurses in an intensive care unit.
- controlling and storing information about specific measurements and parameters of patients for instance in nuclear medical tests on the thyroid gland, blood volume evaluation etc.,



A CAMAC-Operation

- processing and controlling accelerators for irradiation of patients,
- evaluation of scintigrams, ECG and EEG,
- storage of patients history and general administration.

Question: People who have argued against CAMAC say: 'CAMAC is a very expensive system'. Would that be an obstacle to your introduction of CAMAC?

Answer: High prices are a very relative statement. If you have only one crate at 2000 Dollars, one crate controller at 1500 Dollars and only one plug-in unit at 2000 Dollars, the then basic costs are too high. But if you have several units, each for example including 8 or more analog digital converters which are connected to a multiplexer system to read the content of many analog data sources, then the price of a half-filled crate is not too expensive. But the way, the prices of electronic equipment developed by companies which have only their own private standards are of the same order of magnitude. Sometimes such devices are designed for a specific use and seem to be cheaper, but this may be an illusion. After those special measurements come to an end you generally can't use the devices for other applications because they have only specific functions and are also not compatible with equipment from other companies. Besides, I must say that the product line of a single company is limited because they can't produce everything, and therefore the possibilities of their applications in the hospitals are restricted. And last but not least, if the president of such a company feels like rejecting the company's standard because he has the terribly bright idea to change the signal polarity and level from +5 V to −43 V, or something like that, then the user can only despair and throw away his equipment. I would like to say that an international standard system is always better, because the probability of having such problems is much less.

Question: CAMAC is a computer-interface system based on many complicated rules. Are you sure that it can be learned by the technical staff at your hospital?

Answer: We have now the situation that every company delivering equipment to us sends one or two engineers to train our technicians, so they must learn many different systems. It would be much better if they were involved with only one system, where the rules are fixed for a long time.

Question: Now I have a last question. Are the doctors actually happy with the spread of electronics in medicine?

Answer: Well, I think doctors are not fascinated by the hardware. If it is important for the patient, we use electronics where we can. But if we must decide whether to look at the display or at the patient, we look at the patient.

Interviewer: Thank you very much, I think that was an outstanding conclusion to the interview.

Physician: Well, may I also ask a final question?

Interviewer: Oh, sure, please do!

Physician: When you have an accident (and I hope you won't) and your doctor sends you into a hospital with a CAMAC-controlled intensive care unit, are you happy with the thought, that you would be a CAMAC-checked patient?

Interviewer: Oh, that's a very difficult question! I can answer in a parable—I am a physicist and I know a lot about the stability of airplanes and the dynamics of flight, but if I can, I go by train. Is that an answer to your question?

Physician: I am sure it is! Thank you very much.

NEWS

PRESENTATIONS OF CAMAC IN ITALY

Prof. L. Stanchi of CCR Euratom presented a paper entitled 'Lo Standard CAMAC: Un Efficace ed Universale Metodo di Interfaccia per Minicomputer' at the 2nd 'Convegno Internazionale di Elettronica Industriale' held at Turin, 2nd and 3rd October 1973.

A paper on CAMAC hardware, designed to introduce CAMAC to instrument engineers, was presented also by Prof. Stanchi at the course on 'Sistemi di Strumentazione Automatizzata con Minicomputer' organised by ANIPLA, at Milan during 10th to 12th October 1973. Dr. E. de Agostino of CNEN Italy presented a complementary paper at the same course describing CAMAC from a software point of view.

NEW PRODUCTS

DATA MODULES (I/O Transfers and Processing)

Digital Parallel Input Modules

64 Line Surveyor

The 64LS 2052, a single-width CAMAC module, surveys the state of 64 input lines working at TTL logic levels. Each line can be individually identified, addressed and tested, and the module itself has its own variable address stored on a plug-in matrix board. This provides for large equipment configurations, where up to 16,384 lines can be identified.

The module also has a useful role as a LAM grader in multi-crate CAMAC systems.

The module can be instructed by the dataway to perform either individual surveys of the 64 lines, or continuous cycling surveys. Also set by the dataway, the alarm mode can be one of the following:

a) when an input goes to the '0' state;
b) when an input goes to the '1' state;
c) when an input changes state.

The module may be connected directly to the datasource but, due to the varying signal levels and significant disturbance encountered in most existing industrial installations, a galvanic separator is normally required. The SEN IOIS unit fills this requirement.

Ref. SEN Electronique

Digital Output Modules

Dual Output Register

The 2OR 2051 is a single-width CAMAC module containing two 16-bit registers, each of which can be individually addressed and instructed by the Dataway. An 88 pin EMIHUS connector mounted on the front panel accepts the 32 logic signals presented by the two registers.

The module has a 'Handshake' mode of operation, and the WAIT condition of the logic associated with each register is displayed on the front panel. The 2OR 2051 is fully compatible with the SEN 2IR 2002 Dual Input Register (CERN Specs. 072), and the two modules are able to transfer 16-bit words between separate CAMAC configurations when interconnected.

Three versions of this unit are available which cover the most frequently utilised output stages in digital control systems:

2OR 2051	TTL compatible output stages with 30 FAN-OUTs.
2OR 2051HC	Output stages capable of driving heavy loads, 200 mA — voltage max. 24 V.
2OR 2051HV	Output stages capable of driving loads connected to high voltages — for example, gas-filled display tubes.

These output stages are carried on a plug-in printed circuit, and any 2051 module can be easily adapted to one of the alternative versions. Custom made output stages are also available.

Ref. SEN Electronique

Digital I/O, Peripheral and Instrumentation Interfacing Modules

Stepping Motor Driver JCP 20

This single width CAMAC module provides an output to drive a 4-phase motor directly or a frequency output for applications where the motor and its power driver are situated remotely.

Two modes of operation are possible:

- *System mode:* the motor is started by writing the number of steps in 2's complement code into the 'number register' by F(16). A(0).
- *Autonomous mode:* the speed and direction of rotation are defined by external signals. These analogue or digital signals are received via the front panel connector.

A potentiometer connected between +6 V and −6 V provides the motor manual control. The stepping range is 16 or 24 bits.

Ref. SAIP Schlumberger

Analogue Modules

Fast Successive Approximation ADC's Types : 1243, 1243a, 1244, 1244a

The Types 1243 and 1244 ADC's are double-width CAMAC modules offering 10 and 12-bit resolution respectively. Both types operate on the successive approximation principle and are normally supplied with bi-polar inputs having a sensitivity of −5 V to +5 V. Optionally, either type can be supplied with a uni-polar input suitable for either OV to +10 V or −10 V.

All modules are equipped with a sample and hold feature. This permits very narrow time slot measurements to be made e.g. analysis of a relatively slowly changing waveform or, alternatively, highly efficient use of computer time can be made when using one or more Multiplexers by overlapping channel-changing and conversion activities.

A 'Start' input and a 'Scan+1' output are provided so that an ADC can be easily linked to either Type 1704 Multiplexers or other similar but non-CAMAC equipment. Several Multiplexers can be used with one ADC to feed signals from many sources onto the common analogue bus in either a sequentially scanned mode or a random access mode.

Ref. Borer Electronics AG

Model 2249 12-Channel Analogue-to-Digital Converter

As a successor to Model 2248 Octal ADC, the new LRS Model 2249 offers 12 independent 10-bit ADC's operating from a common gate in a single width CAMAC module. Full scale is set at 256 picocoulombs, giving a resolution of .25 pc/count. Digitizing time is 50 microseconds, and a front panel 'fast clear' is provided to permit quick rejection of unwanted data without time consuming digitizing and readout.

For on-line testing, a front panel 'test' input is provided into which precise DC levels may be injected during the gating interval. A charge proportional to this level will then internally be injected into all 12 ADC inputs. The 2249 also offers full LAM structure and power consumption within CAMAC limits for a single station.

Commands: Z or C, I, Q, X, L.
Function Codes: F0, F2, F8, F9, F10, F24, F26.
Available: January, 1974.

Ref. LeCroy Research Systems Corp.

Model 2228 Octal Time-to-Digital Converter

The new LRS Model 2228 consists of eight 10-bit TDC's in a single width CAMAC module. With full scale time ranges of 102 ns and 204 ns, the 2228 offers time resolution of either 100 ps or 200 ps per count. Digitizing time is 50 microseconds, and a front panel 'fast clear' is included to allow prompt rejection of uninteresting data and prepare for the next event without waiting for full conversion and CAMAC readout or clear commands.

The Model 2228 TDC also offers a 'common stop input' to permit precision 'on-line' testing of all channels. The standard LAM structure is included in the 2228, and power requirements are kept within CAMAC limits.

Commands: Z or C, I, Q, X, L.
Function Codes: F0, F2, F8, F9, F10, F24, F26
Available: March, 1974.

Ref. LeCroy Research Systems Corp.

SYSTEM CONTROL (Computer Couplers, Controllers and Related Equipment)

Interfaces/Drivers and Controllers

Model CA11-E Single Crate Controller

The Single Crate Controller Type CA11-E provides a simple, economical means of connecting a CAMAC crate to any PDP-11 Computer. Up to 32 Single Crate Controllers can be connected to one CPU.

The Controller/Interface is mounted in a double width CAMAC unit. The PDP-11 UNIBUS is plugged directly into the front connector of the Controller.

The organisation of the controller is fully transparent, e.g. each CAMAC-module and sub-address is individually addressable from the CPU as a normal PDP-11 device. A total of 1024 addresses are available. The device address and the vector address of each crate is easily selectable by the user through miniature switches on the controller. Optimal data transfer speed results from handshaking timing mode. During a 24 bit transfer an automatic interrupt lock-out is performed.

Ref. Digital Equipment Corporation

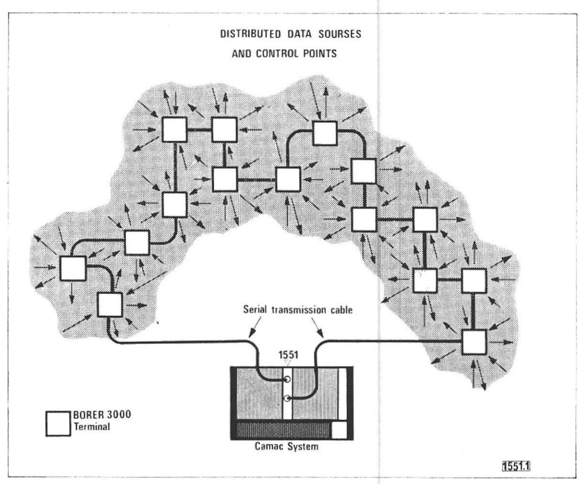
Interfaces/Controllers/ Drivers for Serial Highway

Controller for Borer 3000 System

Extensive flexibility and economy in system planning is possible using the Controller Type 1551 which provides the complete link between a CAMAC system and the Borer 3000 serial transmission data system.

Borer 3000 is a line-sharing system for the collection of data from and distribution of commands to a large number of randomly scattered terminal points. Interconnection of all points is by means of a single twisted-pair ring-cable yet the system can handle arbitrarily mixed analogue and digital inputs and outputs in practically unlimited quantities.

The 1551 Controller is totally responsible for the organisation and management of data transfers on the ring cable. It thereby relieves the CAMAC System, and hence the computer, of all routine work such as security checks, interrupt handling, etc.



Each Controller occupies only two CAMAC stations yet can service up to 256 widely distributed

Terminals on its ring cable. Each Terminal can have up to 32 input/output 'slots' on its standardized internal dataway for the accomodation of inexpensive modules to interface to the application. Such modules can handle up to 2×8 bits of information which may be on-line process data, manually given commands, display information or can be given to or from standard peripherals.

Ref. Borer Electronics AG

Serial Highway Crate Controller

The Kinetic Systems' Model 3950, Type L-1 Crate Controller, provides the interface between the standard serial highway and the crate dataway. It fully complies with the AEC-TID 26488 description of the serial highway. Both bit serial and byte serial parts are provided and data rates can be from arbitrarily slow to 5 Megabytes per second (one dataway cycle every 3.5 μsec for read or write).

Ref. Kinetic Systems

Index to Manufacturer's News and New Products

NEWS

ANNOUNCEMENTS BY CAMAC MANUFACTURERS

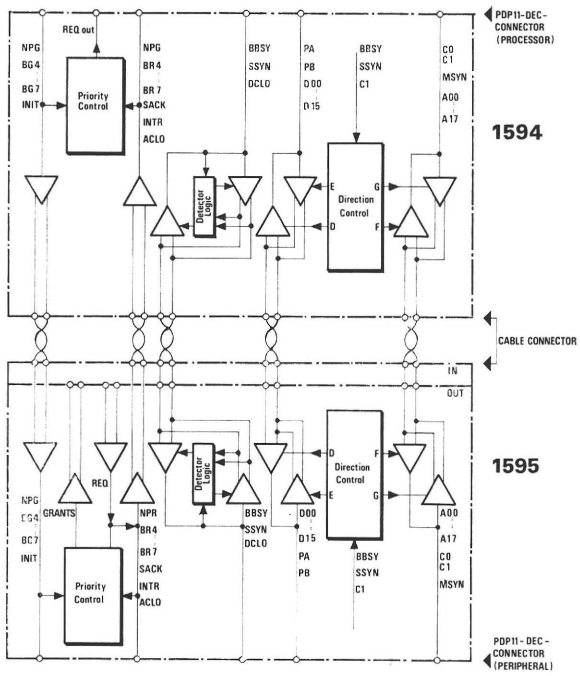
GEC-ELLIOTT PROCESS AUTOMATION LTD. has developed, in collaboration with Imperial College, London, an interface for the Interdata 70 Series of computers and the first was delivered in December 1973. The interface operates as a system crate unit (see CAMAC Bulletin No. 7, page 21) in conjunction with the GEC-Elliott Executive Controller MX-CRT-2; it consists of the singlewidth modules PTI-70C and PTI-70D (Program Transfers Interface, Control and Data respectively) joined by a screw-on front-panel bus, the IUB-3 (Inter Unit Bus). Connection to the computer is via an edge-connector on the front face of IUB-3, and a termination card, if needed, may also be plugged into the IUB-3.

The interface works with the other GEC-Elliott Executive Suite of System Crate units: Branch Coupler (BR-CPR-2) of which up to seven may be used, each driving a full EUR 4600 Branch Highway; IVG-2401, a Standard Interrupt Vector Generator for autonomous demand handling; and SC-TST-1, a System Gate two-command manual unit. In addition, of course, the interface will time-share with any of the other computer interfaces (for GEC 2050 and 4080; PDP-9, 11 or 15; Nova, Honeywell, etc). supplied by GEC-Elliott.

GENERAL AUTOMATION INTERNATIONAL, INC. (USA) is offering a CAMAC Branch Driver – CBD 16 – for its SPC-16 series of mini-computers. The product is designated model no. 72-077. All signal levels and timing conform fully to the requirements of the specification EUR 4600e for CAMAC systems. Up to seven CAMAC crates can be driven by one CBD 16 controller and a maximum of sixteen CBD 16 units can be connected to a standard SPC-16 computer system.

Both programmed I/O data transfer and data channel operation (Direct Memory Access Mode DMA) is possible.

BORER ELECTRONICS AG is offering Unibus extenders for the PDP-11.
The two modular units Type 1594 and 1595 together permit a Unibus to be extended to a length of 200 m (650′) or more for the remote operation of a PDP-11 with one or more peripherals and/or one or more

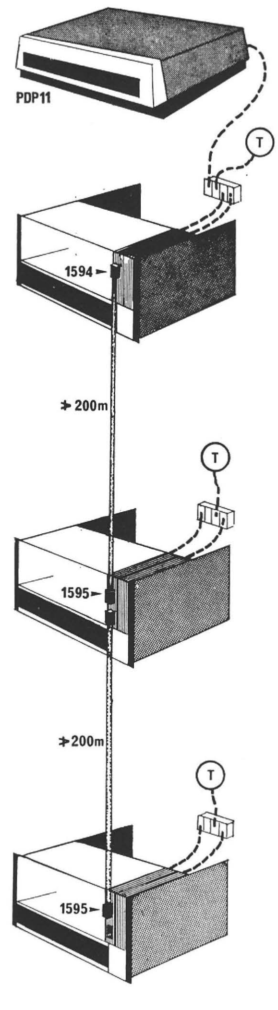


CAMAC crates (via crate-Unibus interfaces such as Borer Type 1533A).

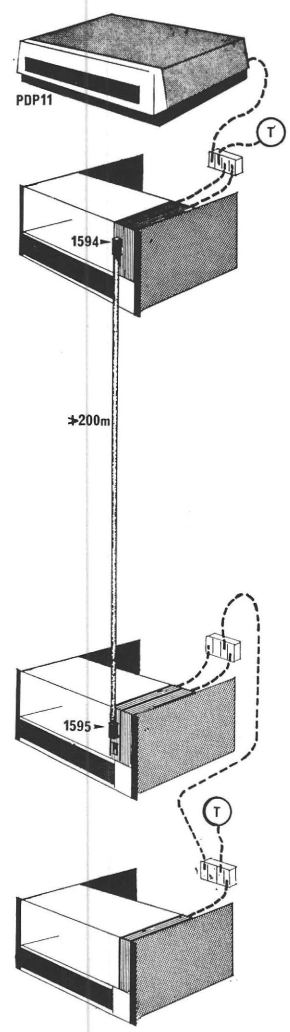
The 1594, placed nearest to the computer, acts principally as a transmitter while the 1595, placed nearest the peripheral device acts as a receiver. Connection between the two units is made by a multiway twisted pair cable. The 1594 is furnished with a single output connector, while the 1595 has twin linked connectors to permit up to 5 or 6 units to be daisy-chained together. Additional transmission stages to extend the total distance covered by steps of 200 m can also be connected.

The signal on the Busy Line (BBSY) determines which unit shall act as master. This same information together with the information on the C1 and INTR lines is used to determine the write/read operation of the 16 bi-directional data lines.

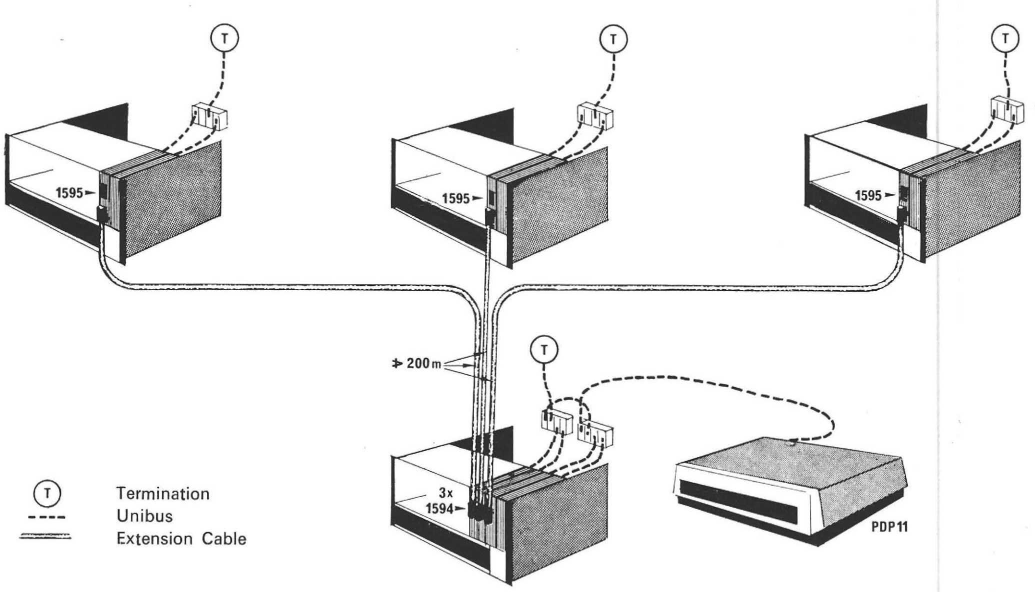
Two versions of each unit are foreseen: both the transmitter and the receiver will be available either as double width CAMAC modules or as self-powered 19″ rack-mounting instruments. As CAMAC modules the instruments would make no contact with the dataway except to draw power (+6 V).



1 local Transmitter feeding 2 remote Receivers



1 local Transmitter feeding 1 remote Receiver, serving 2 crates



3 local Transmitters each feeding a remote Receiver

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

The ESONE Dataway Working Group (EDWG) has continued the development of the CAMAC Serial Highway in close co-operation with the NIM-CAMAC Dataway Working Group (NDWG). A "*Description* of the CAMAC Serial System Organisation" was reviewed finally at the EDWG meeting in Oxford in October and at the NDWG meeting in San Francisco in November 1973. After full agreement, this document (EDWG 25/73 = NDWG 73-10), together with an amendment concerning the use of an auxiliary controller, was presented to the ESONE Annual General Assembly in Luxembourg in December 1973 as a joint effort by the ESONE and NIM Committees. The *Description* received approval by the ESONE General Assembly, and has been endorsed by the ESONE and NIM-Committees as a basis for a formal *Specification*, which will have the same technical content except where changes are needed to correct errors and omissions and to include block transfer features that are being studied by the Working Groups. Documents of the CAMAC Serial System Description are now available with identical text from ESONE in Europe and from AEC NIM in the United States. The Dataway Working Group, in co-operation with its NIM-CAMAC counterpart, is now preparing the *final specification* of the CAMAC Serial System. In order to reduce the risk that early implementations are incompatible with respect to each other or the final specifications, designers intending to implement the Serial System are invited to maintain close contact with the Dataway W.G. and to seek advice about any omissions or ambiguities.

Methods for block transfer in parallel highway systems have been investigated by the Dataway Subgroup on Block Transfer (BTSG) which has met twice in 1973. The results were discussed by both the ESONE Dataway and Software Working Groups at their meetings in Brussels in February 1974. It is expected that recommendations for standard block-transfer mechanisms can be worked out early in 1974, again in agreement with the NIM Working Groups. Decisions on this topic will influence the recommendations for future use of the Branch Highway reserved lines. Most of these lines are about to be released for private use (e.g. to facilitate other methods of fast block transfer or multiple branch and multiple source configurations), with certain restrictions on signal levels etc. The specifications of Crate Controller Type A-1 will not be modified in any way by these recommendations.

Software Working Group

Chairman: I.N. Hooton, AERE Harwell

The principal activity of the Software Working Group has been to finalise the technical specification of IML (the Intermediate Language). The semantics of the language are now agreed, and a syntax appropriate for most modern macro-assemblers has been defined and implemented at Oxford University and at CEN Saclay, on PDP-10 and PDP-11 computers respectively. Further consideration will be given to a compiler syntax and to subroutine implementations.

Co-operation continues with the NIM-CAMAC Software Working Group on all aspects of the definitions, particularly the subroutine implementation of IML where the Group is expected to play a major part.

Close contact is being maintained with the Dataway Working Group, particularly on the topics of the Serial Highway and Block Transfers. The Software Working Group has a representative on the Block Transfer Sub-Group. A representative is also in contact with the European Section of the Purdue Workshop on the topic of the long-term programming language.

Mechanical Working Group

Chairman: F.H. Hale, AERE Harwell

The Annual General Assembly 1973 requested the Working Group to study and arrive at a recommended practice for connections between CAMAC units and installations in industrial process applications. Consequently, opinions, requirements and experience in this field are being assembled in co-operation with the NIM-CAMAC Working Group to form a basis from which a proposal can be made.

Analogue Signals Working Group

Chairman: T. Friese, HMI Berlin

During the ESONE-Conference in Luxembourg Dec. 1973 the ESONE Committee adopted in principle specifications of the analogue Signals (published partly in the Table in CAMAC Bulletin No. 8). Insertions in the abstract and the introduction will restrict these specifications to a 50 Ω-transmission-system for single ended unipolar- and bipolar amplitude analogue signals. Both the NIM and the ESONE AWG agree that recommendations for other transmission systems will have to be considered in the near future, in view of the introduction of CAMAC in applications other than nuclear, e.g. industrial measurement and control. These new recommendations will be worked out in close collaboration with the interested industries.

We hope the NIM-Committee will agree with our opinion that the specifications for the 50 Ω-system should now be published in the present form and the industrial measurement and control signals should be compiled in another new document.

Information Working Group

Chairman: H. Meyer, CBNM, JRC Euratom, Geel, Belgium

During 1973, Issues 6, 7 and 8 of CAMAC Bulletin were published and accompanied by Supplements entitled, "Supplementary Information on CAMAC Instrumentation System", "A CAMAC Glossary", and "CAMAC Bibliography", respectively. By July 1973 the number of subscribed copies of the Bulletin exceeded the "1,000" mark.

The Working Group succeeded in collecting papers reporting non-nuclear applications of CAMAC and describing CAMAC software and the first outcome of the Group's recent work of attempting to classify software for CAMAC is published in this issue (see p. 25). The presentation of hardware products in the Product Guide was improved by the introduction of a new classification.

The 1st International Symposium on CAMAC last December in Luxembourg, has shown that the numbers of CAMAC applications and users in different areas are increasing remarkably. The Proceedings of the Symposium are published as a supplement to this issue (see, p. 24).

The Working Group's efforts to collect and or initiate papers on new CAMAC applications and to improve the content and layout of the Bulletin will continue in such a way as to further support CAMAC promotion.

NIM-CAMAC WORKING GROUPS

Dataway Working Group

Chairman: F. A. Kirsten, Lawrence Berkeley Laboratory

During 1973 the NIM Dataway Working Group (NDWG) met three times—at the National Accelerator Laboratory (NAL), April 3-4; at TRIUMF, Vancouver, B.C., Canada, July 10-11; and at the Lawrence Berkeley Laboratory (LBL), November 9-10.

As usual, communication between the ESONE and NIM Dataway Working Groups was facilitated by representatives at each other's meetings. ESONE guests at the NIM Working Group meetings included:

- R. C. M. Barnes and I. N. Hooton at NAL;
- A. C. Peatfield and H. Klessman at TRIUMF, and
- I. N. Hooton, A. Peatfield and H. Halling at LBL.

The principal business at these meetings was work on preparing the description of the Serial Highway. This was culiminated at LBL by a resolution requesting the NIM Committee to adopt the document "CAMAC Serial System Organization—A Description", written jointly by the NIM and ESONE Dataway Working Groups. Accordingly, the NIM Committee adopted the document on November 13. The ESONE Committee having taken similar action in December, this document will be distributed soon by the NIM Committee as Report TID-26488.

The Serial Sytem Sub-Group, under the Chairmanship of D. R. Machen of the Los Alamos Scientific Laboratory, met on numerous occasions and worked tirelessly in drafting the Description proposals and in refining them in accordance with the results of discussions at the NIM and ESONE DWG meetings. With the completion of the Description having been accomplished, work on implementing serial systems and writing of the formal Specification will proceed.

A sub-group to study the interfacing of CAMAC to other data highway systems has been established with S. R. Smith of NAL as Chairman. Another sub-group has been formed jointly with the NIM Software Working Group to investigate the implementing of block transfers to and from CAMAC modules. This sub-group is chaired by E. J. Barsotti of NAL.

Software Working Group

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

During 1973 the NIM Software Working Group (NSWG) held three meetings; in April, in July and in November, with ESONE guests as listed in the NDWG report above. An evolutionary change in leadership occurred during the year as W. K. Dawson assumed the secretarial duties and R. F. Thomas moved first to Vice-Chairman and later to Chairman of the Working Group. Satish Dhawan, who chaired the NSWG since it was first organized, resigned the chairmanship because of the pressure of other activities, though he is continuing as a member of the Working Group.

The Working Group published descriptions of proposed standard subroutines for CAMAC operations in the April 1973 issue of the IEEE Transactions on Nuclear Science. A few comments have been received, and some revisions are now under consideration. Having thus brought this item of business to a suitable resting place, the Group became a student and critic of two other major activities of NIM and ESONE for 1973, the Serial Highway System Description and the IML proposal. Both of these were studied intensively and many comments and suggestions made.

During the last two meetings, the problem of block transfers within CAMAC was discussed, and a joint sub-group (with the NDWG) was formed to prepare recommendations in this area.

Mechanical & Power Supply Working Group

Chairman: L. J. Wagner, Lawrence Berkeley Laboratory

The NIM Mechanical and Power Supply Working Group met at TRIUMF in Vancouver, B.C., Canada on July 12 and in San Francisco on November 12, 1973. These meetings were concerned with connectors for the Serial System as well as for the CAMAC crates, with power supplies and with mechanical considerations. Low insertion-force Dataway connectors has been a continuing interest.

Dick A. Mack of the Lawrence Berkeley Laboratory retired as Chairman following the November meeting and was replaced by L. J. Wagner, also of LBL.

A request from the ESONE MWG and growing interest in U.S. industry for process control instrumentation point out the need for auxiliary connectors on CAMAC modules which are well suited for process control applications. A number of questions related to compatibility with the basic EUR 4100/TID-25875 specification, and to the signal and mechanical needs and constraints of the process control industry must be answered before recommendations can be made by the NMWG.

Manufacturers who are producing Type CP-1 power supplies based on the description in Appendix E of AEC Report TID-25877 (also issued as Supplement to CAMAC Bulletin No. 6) have forwarded inquiries from their users about the need for greater than 25A on the +6V bus. The EUR 4100/TID-25875 specification explicitly prohibits this in Table X; the burden of enforcement, however, is on the user. Although the Type CP-1 description does not prevent the power supply manufacturers from being responsive to special requirements in this regard, the NMWG discourages such a trend because of bussing limitations in some crates and problems in dissipation of the heat in modules drawing excessive power. Our efforts will be in the direction of minimizing power demands by encouraging users to specify modules which require fewer amperes through the use of low power IC's and careful design.

There is some interest in providing voltages to allow the use of ECL with signal levels directly at the CAMAC "Terminated Signals" level (Table IX, EUR 4100/TID-25875). Since ECL can be used with the 6 volt supplies already bused in CAMAC crates, we recommend against adopting power buses for this special case. (See LBL Report UCRL-20839, November 4, 1971, R.F. Althans and L.W. Nagel. Available from L.J. Wagner, Lawrence Berkeley Laboratory).

The NMWG is in regular contact with manufacturers of CAMAC hardware and power supplies. Current commercial activities in the areas of low insertion-force dataway connectors, coaxial connectors, and type CP-1 power supply connectors are followed closely. For information without prejudice or recommendations, specific inquiries may be directed to Lee J. Wagner, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720. Comments and suggestions regarding mechanical and power supply matters are also invited.

Analog Signals Working Group

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

The NIM Analog Working Group (NAWG) met at TRIUMF in Vancouver, B.C. on July 12 and in San Francisco on November 12 and 14, 1973 to consider the proposed expansion of the analog signal specifications. The ESONE AWG had requested our input with respect to several points. The NAWG response was incorporated in the latest "Specification of Amplitude Analogue Signals within a 50-Ohm System", Luxembourg, December 7, 1973.

Both the ESONE AWG and the NIM AWG recognize the limits of applicability of this specification and this is to be made clear in the document. The NAWG will submit the draft to the NIM Committee for its consideration in February 1974.

Development of further specifications are under consideration to cover standards applicable to industrial control, current-mode signals, differential signals and 10-volt amplitude analog signals.

NEWS

INTERFACING TO THE BRANCH HIGHWAY

A CAMAC Users Request

The ESONE Committee has received from Australia a request for advice about interfacing core memory blocks directly to the CAMAC Branch Highway. The enquirer points out that this offers an attractively-priced extension to the memory of a computer, particularly an older computer. In his reply, the chairman of the ESONE Dataway Working Group discusses several points that are relevant when any device other than Crate Controller Type A is interfaced to the Branch Highway. The possibility of connecting pseudocrates in place of genuine CAMAC crates was considered when the Working Group was preparing the specification EUR 4600e, and the general requirements for compatibility with the Branch Highway were deliberately made less restrictive than those for Crate Controller Type A [e.g. the special significance of N(28) and N(30) need not apply].

The enquiry proposed that an 8k block of core could be addressed by using the 5BN bits, the 4BA bits and BF 1, 2, 4, 8. However, it is not always safe to use BF8 in this way, since some branch drivers rely on BF8, with BF16, to determine the direction of data transfer and may legitimately not transfer data when BF8 is logic '1'. This limits the addressing capability at one crate address to 4k, but in principle the memory block could occupy more than one crate address.

When addressed with a command operation the pseudo-crate must obviously generate the correct BTB_i responses. Since some branch drivers automatically address all on-line crates during a Granded-L operation (having previously identified them by their BTB_i signals) it is advisable that the pseudo-crate should also make the normal BTB_i responses during a Granded-L operation, in order to avoid locking up the Branch Highway timing handshake. A pseudo-crate need not implement BQ, but must generate $BX = 1$ when it is correctly addressed.

PAPER ABSTRACTS TRANSLATIONS

MULTILAB - A laboratory automation system based on modus 4 and CAMAC
P.M. Hills

Summary

The time-sharing laboratory automation system MULTILAB uses CAMAC and one or more Modular One computers. The history of such schemes is discussed, together with system characteristics, typical CAMAC interfaces, performance and software hierarchy.

Zusammenfassung

Das Time-sharing (Teilnehmersystem) MULTILAB für die Labor-Automation arbeitet mit CAMAC sowie mit einem oder mehreren Modular-One-Rechnern. Nach einem Überblick über die Vorgeschicht solcher Projekte werden die Merkmale des Systems, typische CAMAC-Schnittstellen, das Leistungsvermögen und die Software-Hierarchie erörtert.

Résumé

MULTILAB, système d'automatisation de laboratoire fonctionnant en temps partagé, est basé sur l'utilisation de CAMAC et d'un ou plusieurs ordinateurs "Modular One". Cet article retrace l'historique du système et traite de ses caractéristiques, des interfaces spécifiques CAMAC, des performances atteintes et de la hiérarchie du software.

Riassunto

Nel sistema di automazione da laboratorio MULTILAB in "time sharing" s'impiega il CAMAC con uno o più calcolatori "Modular One". Viene discussa la storia di tali configurazioni assieme alle caratteristische del sistema, alle tipiche interfacce, alle prestazioni e alla gerarchia dei programmi.

Samenvatting

Bij MULTILAB, een time-sharing systeem voor laboratorium automatisering, wordt gebruik gemaakt van CAMAC en een of meer Modular One Computers. Er wordt een overzicht gegeven van de ontwikkeling van dergelijke opstellingen, de eigenschappen van het systeem, de CAMAC interfaces, de mogelijkheden en de opbouw van de software.

Резюме

Система МУЛТИЛАБ автоматизации лаборатории, работающей с разделением времени, применяет CAMAC вместе с одной или несколькими ЭВМ Modular One. Рассмотрена история этой системы как и её характеристики, типичные интерфейсы CAMAC, свойства и иерархия программ.

CAMAC at LAMPF
D. R. Machen

Summary

The CAMAC standard has been adopted for general use in data acquisition and control systems at the Clinton P. Anderson Meson Physics Facility, one of America's newest national laboratories. This paper is a brief description of current CAMAC activities at LAMPF.

Zusammenfassung

Bei der Clinton P. Anderson Meson Physics Facility, einem der modernsten staatlichen Forschungsinstitute der USA, wird der CAMAC-Standard allgemein in der Datenerfassung und für Steuersysteme eingesetzt. Die Arbeiten mit CAMAC an diesem Institut werden kurz beschrieben.

Résumé

La norme CAMAC a été adoptée par le «Clinton P. Anderson Meson Physics Facility», un des plus récents laboratoires nationaux des USA, pour les systèmes d'acquisition de données et les systèmes de commande. Cet article donne une brève description des activités CAMAC actuelles au LAMPF.

Riassunto

Il CAMAC è stato adottato in tutti i sistemi di acquisizione di dati e di controllo dell'Istituto Clinton P. Anderson Meson Physics Facility, uno dei più recenti laboratori nazionali americani. Nel documento si descrivono brevemente le attuali attività CAMAC presso il LAMPF.

Samenvatting

De CAMAC-standaard wordt algemeen toegepast in data acquisition and control systems bij de Clinton P. Anderson Meson Physics Facility, een van de nieuwste amerikaanse laboratoria.
Dit artikel beschrijft in het kort de huidige CAMAC activiteiten bij LAMPF.

Резюме

Стандарты CAMAC находят общее применение в системах сбора данных и управления в одной из самых новых американских лабораторий (Clinton P. Anderson) физики мезонов. В статье описаны текущие работы по CAMAC-у.

A CAMAC time-of-flight scaler
D. A. Boyce and D. V. Morris

Summary

This versatile 16-bit scaler is used for two-parameter neutron time-of-flight measurements at a pulsed 45 MeV electron linear accelerator. Correlated words representing flight times (measured by the scaler) and particle energies (measured by an analogue-to-digital converter) are transferred by a CAMAC system to a PDP-11/45 computer.

Zusammenfassung

Diese vielseitige 16-bit-Zähleinrichtung wird für Neutronenflugzeitmessungen mit zwei Parametern an einem gepulsten 45 MeV-Linearbeschleuniger eingesetzt. Korrelierte Wörter, die den (mit der Zählvorrichtung erfaßten) Flugzeiten und den (mit einem Analog-Digital-Wandler gemessenen) Teilchenenergien entsprechen, werden über ein CAMAC-System zu einem PDP-11/45 Rechner übertragen.

Résumé

Cette échelle de comptage à 16 bits, d'usage général, est utilisée pour les mesures biparamétriques du temps de vol des neutrons dans un accélérateur linéaire pulsé d'électrons de 45 MeV. Des mots corrélés représentant des temps de vol (mesurés par l'échelle) et des énergies de particules (mesurées par un convertisseur analogique/digital sont transférés par un système CAMAC à un ordinateur PDP-11/45.

Riassunto

Questo versatile contatore d'impulsi a 16 bit è impiegato per misure biparametriche di tempo di volo di neutroni, in un acceleratore lineare pulsato di elettroni da 45 MeV. Le parole correlate che rappresentano i tempi di volo (misurati dal contatore) e l'energia delle particelle (misurate da un convertitore analogico-digitale) sono trasferite da un sistema CAMAC ad un calcolatore PDP-11/45.

Samenvatting

Beschreven wordt een veelzijdige 16-bits scaler, die gebruikt wordt bij twee-parameter neutronen looptijd metingen bij een gepulste 45 MeV lineaire elektronen versneller. De looptijd (gemeten door de scaler) en de energie van de deeltjes (gemeten door een ADC) worden door een CAMAC-systeem overgebracht naar een PDP-11/45 computer.

Резюме

Этот 16-битовой счётчик применяется в двухмерных измерениях времени пролёта на импульсном, линейном 45 MeV ускорителе электронов. Через CAMAC передаются в ЭВМ PDP-11/45 коррелированные слова, представляющие время пролёта (измеряемые счетчиком) и энергии частиц (измеряемые ЦАП-ом).

A Teletype-controlled CAMAC branch driver
D. Kollbach

Summary

This branch driver is an interface between a Teletype machine and the CAMAC Branch Highway. It is used for testing and servicing CAMAC equipment. A repetitive mode of operation is available to support the use of an oscilloscope.

Zusammenfassung

Dieser Branch-Treiber ist ein Interface (Schnittstelle) zwischen einem Fernschreiber und dem CAMAC-Branch Highway. Er wird zum Testen und zur Wartung von CAMAC Gerät benutzt. Da im Wiederholbetrieb gearbeitet werden kann, ist der Einsatz eines Bildschirms möglich.

Résumé

Cette commande de branche est une interface entre une télétype et l'Interconnexion de branche CAMAC. Elle est utilisée pour le contrôle et la maintenance des équipements CAMAC. On dispose d'un mode de fonctionnement périodique qui permet l'utilisation d'un oscilloscope.

Riassunto

Questo elemento di comando del ramo fa da interfaccia fra una telescrivente e il collegamento del ramo principale CAMAC ed è impiegato per il collaudo e la manutenzione delle apparecchiature CAMAC. Esiste la possibilità di un funzionamento ripetitivo per permettere l'uso di un oscillografo.

Samenvatting

Deze Teletype-gestuurde Branch driver wordt gebruikt voor het testen en onderhouden van CAMAC apparatuur. In verband met het gebruik van een oscilloscoop kunnen de opdrachten herhaald worden met een frequentie van ca. 30 kHz.

Резюме

Этой драйвер ветви является интерфейсом между телетайпом и магистралью ветви CAMAC. Применяется для проверки и ремонта оборудования CAMAC. Чтобы обеспечит возможность использования осциллографа предусмотрена работа в режиме повторения.

Serial CAMAC module
G. Brandenburg

Summary

A CAMAC module, based on LSI MOS packages, has been developed for serial input/output transfers in synchronous or asynchronous mode.

Zusammenfassung

Ein auf LSI MOS-Schaltkreisen basierender CAMAC-Modul ist für serielle Eingabe/Ausgabe-Übertragungen bei Synchron- oder Asynchronbetrieb entwickelt worden.

Résumé

Un module CAMAC construit autour de fonctions logiques LSI MOS a été développé pour les transferts entrée/sortie série, en mode synchrone ou asynchrone.

Riassunto

È stato sviluppato un modulo CAMAC composto da circuiti LSI MOS, per trasferimenti seriali di ingresso-uscita sincroni o asincroni.

Samenvatting

Beschreven wordt een CAMAC moduul, geschikt voor het in serie (synchroon of asynchroon) transporteren van data. Hierbij is gebruikt gemaakt van Motorola MOS LSI zender en receiver chips.

Резюме

Разработан блок CAMAC на интегральных схемах MOS-LSI для передачи в двух направлениях в синхронном или асинхронном режиме.

A CAMAC serial branch adapter
E. Kwakkel and G. Messing

Summary

The Serial Branch Adapter is a branch driver with interfaces to the CAMAC parallel Branch Highway and a serial highway. It allows seven crates, with controllers Type A, to operate as a remote sub-system via the serial highway, which is based on an interim proposal for the CAMAC serial system.

Zusammenfassung

Die serielle Branch-Anpassungseinheit ist ein Branch-Treiber mit Anschlüssen an den parallelen CAMAC-Branch Highway und an einen seriellen Highway. Er gestattet den Einsatz von bis zu sieben Rahmen mit Steuerung Typ A für den Betrieb als ortsfernes Sub-System über den seriellen Highway, der auf einem vorläufigen Vorschlag für ein serielles CAMAC-Übertragungssystem basiert.

Résumé

L'Adaptateur de branche série est un châssis de commande de branche équipé d'interface avec l'Interconnexion de branche CAMAC parallèle et d'une Interconnexion série. Ce dispositif permet à sept châssis, munis de contrôleurs type A, de fonctionner comme un sous-système à distance, par l'intermédiaire de l'Interconnexion série, basée sur une description provisoire de la Branche série CAMAC.

Riassunto

L'adattatore seriale di ramo è un elemento di comando di ramo, provvisto d'interfacce al collegamento parallelo del ramo principale CAMAC e al collegamento principale serie. Esso può collegare fino a sette contenitori, con moduli di controllo tipo A, che funzionano come sottosistemi a distanza attraverso il collegamento principale serie, secondo quanto indicato in una proposta provvisoria per il sistema CAMAC serie.

Samenvatting

De door het IKO (Amsterdam) ontworpen CAMAC Serial Branch Adapter (SBA) is een aanpassing tussen de crate controllers type A en de serial highway. De SBA, waarmee maximaal 7 crate controllers kunnen worden bestuurd, is gebaseerd op een interim rapport over de CAMAC serial highway (april 1973).

Резюме

Адаптор Последовательной Ветви является драйвером параллельной магистрали ветви и интерфейсом последовательной ветви. Это допускает работу 7 крейтов с контроллерами типа A как отдаленной суб-системы, через последовательную ветвь согласно последним предложениям по последовательным системам CAMAC.

A modular microcomputer in the CAMAC system
A. Starzyński

Summary

Single-crate CAMAC systems can be operated by this modular microcomputer, constructed in CAMAC format and housed in the controlled crate. Several configurations are proposed, to cover tasks of differing complexity. The system can replace an external computer, and offers a significant higher rate of CAMAC operations and lower cost.

Zusammenfassung

CAMAC-Systeme mit einem Rahmen können von diesem Kleinstrechner in Modularbauweise betrieben werden. Der im CAMAC-Format hergestellte Rechner wird in dem gesteuerten Rahmen untergebracht. Mehrere Konfigurationen — für Aufgaben unterschiedlicher Komplexität — werden behandelt. Das System kann einen externen Rechner ersetzen. Es bietet den Vorteil einer wesentlichen Beschleunigung der CAMAC-Operationen bei geringerem Kostenaufwand.

Résumé

Les systèmes CAMAC monochâssis peuvent être commandés par ce micro-ordinateur modulaire au format CAMAC et logé dans le châssis contrôlé. Plusieurs configurations sont proposées pour permettre d'effectuer des tâches de complexités diverses. Le système peut remplacer un ordinateur extérieur et permet un taux d'opérations CAMAC sensiblement plus élevé, bien qu'à moindre coût.

Riassunto

Sistemi CAMAC a singolo contenitore possono essere controllati da questo microcalcolatore modulare, costruito in formato CAMAC e alloggiato nel contenitore controllato. Sono proposte diverse configurazioni per compiti di varia difficoltà. Il sistema può sostituire un calcolatore esterno, ed offre una cadenza di operazioni CAMAC significativamente maggiore ed un costo minore.

Samenvatting

Single crate CAMAC systemen kunnen bestuurd worden door deze microcomputer, die gebouwd is overeenkomstig de CAMAC vorm en gebruik maakt van het controller station en twee normale stations. Er worden verschillende configuraties voorgesteld. Het systeem kan een computer vervangen en biedt dan een beduidend hogere snelheid terwijl de kosten lager liggen.

Резюме

Одно-крейтная система CAMAC может работать с модулярным микрокомпутером, созданным по стандартам CAMAC и помещенным в управляемом крейте. Предложено несколько конфигураций для обслуживания задач разной сложности. Система может заменить внешний компутер и обеспечить значительно большую скорость выполнения операций CAMAC при более низкой стоимости.

A CAMAC module for dc motor control
M. Michalski

Summary

This module (Type 570) is used in conjunction with an external thyristor supply to control a separately-excited dc motor. Speed and direction of rotation are normally demanded via the Dataway, but external signal inputs are provided for manual control.

Zusammenfassung

Dieser Modul (Typ 570) wird in Verbindung mit einer externen Thyristor-Versorgung zur Steuerung eines getrennt erregten Gleichstrommotors benutzt. Drehgeschwindigkeit und Drehrichtung werden über den Datenweg abgefragt; für die Steuerung von Hand ist jedoch externe Signaleingabe vorgesehen.

Résumé

Ce module (type 570) est utilisé en association avec un système d'alimentation extérieur à thyristor, pour commander un moteur à courant continu à excitation séparée. La vitesse et le sens de la rotation sont normalement demandés, par l'Interconnexion de châssis, mais les entrées des signaux extérieurs permettent une commande contrôlée manuellement.

Riassunto

Questo modulo (Tipo 570) viene usato con un'alimentazione esterna a diodi controllati per comandare un motore a corrente continua ad eccitazione indipendente. La velocità e il senso di rotazione sono normalmente controllati attraverso l'Interconnessione, ma sono disponibili ingressi esterni di segnale per il controllo manuale.

Samenvatting

Dit moduul (type 570) wordt gebruikt met een externe thyristorvoeding voor het regelen van een gelijkstroommotor. Snelheid en draairichting worden normaal via de dataway geregeld, maar handbediening is mogelijk met behulp van externe signalen.

Резюме

Этот блок (типа 570) вместе с внешним тиристорным задающим устройством управляет двигателем постоянного тока с внешним возбуждением. Скорость и направление движения задаётся нормально по магистрали но все таки предусмотрен вход для ручного управления.

A fast pattern unit with CAMAC readout

H. Quehl, H.-J. Stuckenberg and H. Brechtel

Summary

This CAMAC module accepts 16 fast input signals. After discrimination and shaping, the inputs are strobed by a coincidence signal (resolving time 5 µs) into a buffer register, from which the pattern can be read via the CAMAC dataway.

Zusammenfassung

Dieser CAMAC-Modul verarbeitet 16 schnelle Eingabesignale. Nach Diskriminierung Formung werden die Eingaben mit Hilfe eines Koinzidenzsignals (Auflösungszeit 5 µs) in ein Pufferregister übertragen, dessen Inhalt über den Datenweg gelesen werden kann.

Résumé

Ce module CAMAC admet 16 signaux d'entrée rapides. Après discrimination et mise en forme, les entrées sont échantillonnées à l'aide d'un signal de coincidence (temps de résolution 5 µs) et stockées dans une mémoire tampon dont le contenu peut être lu au moyen de l'Interconnexion CAMAC.

Riassunto

Questo modulo CAMAC accetta 16 segnali rapidi d'ingresso. Dopo la discriminazione e la formazione dell'ampiezza i segnali d'ingresso sono campionati da un segnale di coincidenza (tempo di risoluzione 5 µs) e passano in un registro di transito, la cui configurazione può essere letta tramite l'Interconnessione CAMAC.

Samenvatting

Dit CAMAC-moduul heeft 16 ingangen voor snelle signalen. Na discriminatie worden de 16 signalen met behulp van een coïncidentiesignaal in een bufferregister gepoort. Hieruit kan men via de Dataway het patroon van de ingangssignalen lezen.

Резюме

Блок принимает 16 быстрых входных сигналов. После дискриминации и формирования входы стробируется сигналами совпадения (разрешающие время 5 µs) в буферный регистр, из которого могут считиваться через магистраль CAMAC.

Classification of CAMAC Software

P. Christensen

Summary

This proposed classification of CAMAC Software is an extension of the scheme used for the CAMAC Hardware Product Guide. An example of a CAMAC Software Guide illustrates the use of this classification. A form summarising the Data needed for the exchange of Software documentation is included.

Zusammenfassung

Die für CAMAC-Software vorgeschlagene Klassifikation ist eine Erweiterung des für die CAMAC-Hardware entwickelten Schemas. Eine Übersicht über CAMAC-Software dient als Beispiel für die Benutzung dieser Klassifikation. Der Bericht enthält eine Zusammenfassung der für den Austausch von Software-Dokumentation erforderlichen Daten.

Résumé

La présente proposition de classification du software CAMAC est une extension de la classification utilisée pour le Catalogue des produits hardware CAMAC. Un exemple du catalogue software CAMAC illustre l'utilisation de cette classification.
Un formulaire résumant les données nécessaires aux échanges de documentation est annexé au présent exposé.

Riassunto

La classificazione proposta per il software CAMAC costituisce una estensione dello schema usato per la Guida dei prodotti hardware CAMAC. Un esempio di Guida software CAMAC illustra l'uso della classificazione.
Si allega un formulario che riassume i dati necessari per lo scambio di documentazione software.

Samenvatting

De voorgestelde classificatie voor CAMAC-software vormt een uitbreiding van het schema dat is toegepast voor de CAMAC-Hardware Product Guide. Het gebruik van deze classificatie wordt toegelicht aan de hand van een voorbeeld van CAMAC Software Guide.
Een formulier met een samenvatting van de gegevens die nodig zijn voor de uitwisseling van documentatie betreffende software is opgenomen.

Резюме

Предложенная классификация програмного обеспечения CAMAC является продолжением схемы, примененой в перечене изделий CAMAC. Пример показывает метод использования классификации в перечене программ. Добавлен бланк содержающий данные необходимые для обмена документации программ.

CAMAC PRODUCT GUIDE

This guide consists of a list of CAMAC equipment which is believed to be offered for sale by manufacturers in Europe and the USA. The information has been taken from a CAMAC Products Reference compiled by CERN-NP-EL II from manufacturers' catalogues, advertisements and written communications available to them on the 31st January 1974.

Every effort has been made to ensure the completeness and accuracy of the list, and it is hoped that most products and manufacturers have been included. Inclusion in this list does not necessarily indicate that products are fully compatible with the CAMAC specifications nor that they are recommended or approved by the ESONE Committee. Similarly, omission from this list does not indicate disapproval by the ESONE Committee. Users are advised to obtain detailed information from the manufacturers or their agents in order to check the compatibility and operational characteristics of equipment.

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

There are about 120 new entries this time, bringing up the total to some 1000 products.

How to search for appropriate class: As a first approach use the relatively coarse classification listed below. In the Index of Products you will find a heading for each three-decimal class.

Remarks on some columns in the Index of Products

Column

N/C – N is new, C is corrected entry.

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

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

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

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

CLASSIFICATION GROUPS

INDEX OF PRODUCTS

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR

1 DATA MODULES — I/O TRANSFERS AND PROCESSING

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

111 Simple Serial Binary Registers

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	1X24 BIT BINARY BLIND SCALER (20MHZ NIM OR 10MHZ TTL I/P,EXT INHIBIT IN,OVF O/P)	J EB 10	SAIP/SCHLUMBERGER	1	/71	
	MINISCALER (2X16BIT,30MHZ,SEPARATE GATES AND EXTERNAL RESET,NIM LEVELS)	1002	BORER	1	/69	
	MINISCALER (2X16BIT,30MHZ,SEPARATE GATES AND EXTERNAL RESET,NIM LEVELS)	002	NUCL. ENTERPRISES	1		
	MINISCALER(2X16BIT,30MHZ,SEPARATE GATES AND EXT RESET,NIM LEVELS)	C 104	RDT	1	/71	
	DUAL 150 MHZ 16 BIT SCALER (ONE 50 OHMS, ONE UNTERMINATED NIM INPUT PER SCALER)	2S 2024/16	SEN	1	/70	
	DUAL 24 BIT BINARY SCALER (15MHZ, NIM OR TTL INPUTS)	FHC 1313	BF VERTRIEB	1	/72	
	DUAL 24-BIT COUNTING REGISTER (50MHZ)	C-DS-24	WENZEL ELEKTRONIK	1	/72	
	DUAL 100MHZ SCALER (2X24 BIN BITS OR 2X6 BCD DIGITS,DISCR LEVEL -0,5V)	80A	JORWAY	1	/70	(1)
	DUAL 150 MHZ 24 BIT SCALER (ONE 50 OHMS, ONE UNTERMINATED NIM INPUT PER SCALER)	2S 2024/24	SEN	1	/70	
	MICROSCALER (4X16BIT,2X32BIT SELECTABLE, 25MHZ,COMMON GATE,NIM LEVELS)	1003	BORER	1	/69	
	QUAD CAMAC SCALER (4X16BIT OR 2X32BIT, 40MHZ)	1004	BORER	1	/72	
	TIME DIGITIZER (4X16BIT,50MHZ CLOCK,WITH CENTRE FINDER, USABLE WITH PRE-AMP 511)	1005	BORER	1	/72	
N	QUAD SCALER TYPE 003 (4X16BIT,50MHZ)	S003	EG&G	1	/73	
	SERIAL REGISTER (4X16BIT,2X32BIT SELECTABLE,25MHZ,COMMON GATE,NIM LEVELS)	SR 1605	GEC-ELLIOTT	1	/71	
	QUAD 40 MHZ SCALER (4X16BIT,2X32BIT SELECTABLE,INDIV HI-Z INHIBITS, NIM)	SR 1606	GEC-ELLIOTT	1	/71	
	MICROSCALER (4X16 BIT,25MHZ,OPTIMIZED INPUT,3 NSEC,GIVES TYP 80MHZ COUNTING)	003-4	NUCL. ENTERPRISES	1	/71	(5)
	MICROSCALER(4X16BIT,2X32BIT SELECTABLE, 25MHZ,COMMON GATE,NIM LEVELS)	C 102	RDT	1	/71	
	4X16 BIT BINARY BLIND SCALER (30 MHZ, 2X32BIT SELECTABLE,COMMON GATE,NIM/TTL)	J EB 20	SAIP/SCHLUMBERGER	1	/71	
	FOUR-FOLD SCALER (4X16BIT,2X32BIT SELECTABLE,50MHZ,COMMON GATE,NIM LEVELS)	4 S 2003/50	SEN	1	/69	
	FOUR-FOLD CAMAC SCALER (4X16BIT,40MHZ, ONE 50 OHMS,ONE HI-Z NIM I/P PER SCALER)	4 S 2004	SEN	1	/70	
	TIME DIGITIZER(4X16BIT,CLOCK RATE 70/85MHZ, WITH CENTER FINDING LOGIC)	TD 2031	SEN	1	/72	
	TIME DIGITIZER (4X16BIT,CLOCK RATE 70/85MHZ,NIM LEVELS)	TD 2041	SEN	1	/72	(4)
	SERIAL REGISTER (4X16BIT,2X32BIT SELECT-ABLE,100MHZ,COMMON GATE,NIM LEVELS)	SR 1608	GEC-ELLIOTT	1	/71	
	QUAD 100 MHZ SCALER(4X16/24BIT,-0,5V I/P THRESHOLD,COMMON EXT FAST INHIBIT,NIM)	2550B	LRS-LECROY	1	/70	
	FOUR-FOLD SCALER(4X16BIT,2X32BIT SELECT-ABLE,100MHZ,COMMON GATE,NIM LEVELS)	4 S 2003/100	SEN	1	/70	
	QUAD SCALER (4X24BIT, 50MHZ, DATAWAY AND/OR EXT FAST INHIBIT, NIM LEVELS)	S424S	EG&G	1		(7)
	QUAD COUNTING REGISTER(4X24BIT,NIM INPUT TTL INHIBIT IN,TTL CARRY AND OVF OUT)	709-2	NUCL. ENTERPRISES	1	/71	
	SCALER (4X24BIT, 50MHZ)	9051	NUCL. ENTERPRISES	1	/73	
	QUAD SCALER (4X24BIT,150/125MHZ,DATAWAY AND/OR EXT FAST INHIBIT,NIM LEVELS)	S424B	EG&G	1	/71	
	QUAD SCALER (4X24BIT, 200MHZ, DATAWAY AND/OR EXT FAST INHIBIT, NIM LEVELS)	S424F	EG&G	1		

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	QUAD COUNTING REGISTER (4X24BIT, 100MHZ, NIM + TTL LEVELS, TTL CARRY OVF, BINARY)	300	HYTEC	1	/73	
	QUAD SCALER (4X24BIT, 125MHZ,INTERRUPT STRUCTURE, INDIVIDUAL INHIBIT INPUTS)	S1	JOERGER	1	/72	(5)
	QUAD SCALER (4X24BIT, 200MHZ,INTERRUPT STRUCTURE, INDIVIDUAL INHIBIT INPUTS)	S1-1	JOERGER	1	/73	
	QUAD 100MHZ SCALER (4X24BIT,DISCR LEVEL -0,5V,TIME-INTERVAL APPL,NIM INHIB I/P)	84	JORWAY	1	/71	(2)
	HEX TTL/NIM 50 MHZ SCALER	3610	KINETIC SYSTEMS	1	/73	
	HEX NIM 100 MHZ SCALER	3615	KINETIC SYSTEMS	1	/73	(8)
	OCTAL SCALER (12BITS,8 INPUTS,50MHZ,EACH SCALER GIVES EXT INHIBIT,NIM LEVELS)	S812	EG&G	1	/71	

112 Simple Serial Decade Registers

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

113 Preset Serial Binary Registers

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	16 BIT PRESETTABLE INTERVAL COUNTER	2201	BI RA SYSTEMS	1	/73	
	PRESET COUNTING REGISTER (16BIT,10MHZ, NIM/TTL I/P,TTL INHIB + O/P,DATAWAY SET)	7039-1	NUCL. ENTERPRISES	1	/70	
	24 BIT PRESETTABLE INTERVAL COUNTER	2202	BI RA SYSTEMS	1	/73	
	PRESET 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	
	SCALER 50 MHZ (12/16/18/24BIT,PRESET WITH OVF LINE,CONSTANT DEADTIME)	C 72451-A3-A1	SIEMENS	1	/72	
	PRESETTABLE SCALER (24BIT,30MHZ, WITH BUFFER STATICIZING DATA DURING READ-OUT)	C-PS-24	WENZEL ELEKTRONIK	1	/72	
	DUAL PRESET COUNTING REGISTER(16BIT BIN)	2204	BI RA SYSTEMS	1	/73	
N	DUAL PRESET SCALER (2X16BIT,5MHZ, NIM FAST LOGIC LEVELS)	PS016	EG&G	1	/73	
	DUAL 50 MHZ SCALER-TIMER (24 BITS)	2101	BI RA SYSTEMS	2	01/74	
	2X24 BIT PRESET SCALER (100MHZ COUNTING)	J EP 30	SAIP/SCHLUMBERGER	1	/73	
	QUAD COUNTING REGISTER (4X24BIT, 500MHZ, NIM + TTL LEVELS, TTL CARRY OVF, BINARY)	310	HYTEC	1	/73	

114 Preset Serial Decade Registers

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	REAL TIME CLOCK, LIVE TIME INTEGRATOR, PRESET TIMER	RC014	EG&G	1	/73	
	REAL TIME CLOCK (3,8 USEC TO 18,2 HRS, PRESET-TIME AND PRESET-COUNT MODES)	RTC 2014	SEN	1	/71	
	24BIT BCD PRESET-SCALER (12MHZ, NIM OR TTL INPUTS,MANUAL OR DATAWAY PRESET)	FHC 1301	BF VERTRIEB	2	/71	(1)
	24BIT BCD PRESET-SCALER (12MHZ, NIM OR TTL INPUTS,DATAWAY PRESET)	FHC 1302	BF VERTRIEB	1	/71	(1)
	6 BCD DECADE SCALER (MANUAL AND DATAWAY PRESET,1 MHZ, START/STOP OUTPUT)	J EP 20	SAIP/SCHLUMBERGER	2	/71	
	PRESET SCALER (20MHZ,8DECADE BCD,7 SEGM LED INDICATES CONTENTS AND PRESET NO)	PSR 0801	GEC-ELLIOTT	1	/72	(7)
	PRESET SCALER(10MHZ,8 DECADE BCD,DISPLAY OF 2 SIGNIF NUMBERS+EXP,MAN PRESET,NIM)	C 103	RDT	3	/71	
	DUAL PRESET COUNTING REGISTE(4 DECADES)	2204	BI RA SYSTEMS	1	/73	
	QUAD COUNTING REGISTER (4X24BIT, 500MHZ, NIM + TTL LEVELS, TTL CARRY OVF, BCD)	311	HYTEC	1	/73	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR

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

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

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

121 Non-Storing Registers (Gates)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	PARALLEL INPUT GATE (1X16BIT, TTL)	2411	BI RA SYSTEMS	1	/73	
	PARALLEL INPUT GATE (1X24BIT, TTL)	2421	BI RA SYSTEMS	1	/73	
	INPUT GATE (24BIT, SOURCE SELECTION BY 6BIT OUTPUT, DATAWAY GEN STROBE OUT)	J 007	JORWAY	0		(8)
	INPUT GATE 24-BIT	3420	KINETIC SYSTEMS	1	/71	(4)
	PARALLEL INPUT GATE (24BIT STATIC DATA, INTEGRATED FOR 1 USEC,TTL LEVELS)	7059-1	NUCL. ENTERPRISES	1	/70	
	PARALLEL INPUT GATE (22BIT STATIC DATA, 500 NSEC INTEGRATION,STROBE SETS L,TTL)	7060-1	NUCL. ENTERPRISES	1	/70	
	24-BIT ISOLATED INPUT GATE	3471	KINETIC SYSTEMS	1	/73	
	PARALLEL INPUT GATE (2X16BIT, TTL)	2412	BI RA SYSTEMS	1	/73	
C	STATIC DIGITAL INPUT (2X16BIT, TTL)	C 76451-A8-A4	SIEMENS	1	/73	(6)
	DUAL 24 BIT PARALLEL INPUT GATE (TTL)	2422	BI RA SYSTEMS	1	/73	
	DUAL PARALLEL STROBED INPUT GATE(2X24BIT HANDSHAKE MODE TRANSFER TO DATAWAY,TTL)	61	JORWAY	1	/70	
	DUAL PARALLEL INPUT GATE (2X24BIT,NON-INTERLOCK CONTROL TRANSF TO DATAWAY,TTL)	61-1	JORWAY	1	/70	
	INPUT GATE DUAL 24 BIT	3472	KINETIC SYSTEMS	1		
C	INPUT GATE (2X24BIT STATIC DATA,INTEGR FOR 1USEC,TTL LEVELS,IN VIA 50-WAY CONN)	320	POLON	1	/73	
	DUAL 24 BIT PARALLEL INPUT GATE (WITH LED DISPLAY OPTION)	PG-604	STND ENGINEERING	1	/72	(6)
	PARALLEL INPUT GATE (3X16BIT INPUT FROM ISOLATING CONTACTS)	1061	BORER	1	/72	(4)
	3X16-BIT INPUT GATE (INPUTS ISOLATED BY OPTO-COUPLERS)	1063	BORER	1	/73	(8)
	DIGITAL INPUT REGISTER WITH OPTO COUPLER (4X8BIT PARALLEL INPUT GATES,WITH L)	DO 200-2003	DORNIER	1	/72	
	(WITH FRONT PANEL CONNECTOR)	DO 200-2203		1	/72	
	PARALLEL INPUT GATE(16X16BIT,TTL, 1=LOW)	IG 25601	GEC-ELLIOTT	2	/72	
	128 BIT RECEIVER (ADDRESSABLE AS 8 16BIT WORDS OR 128 1-BIT WORDS)	C 341	INFORMATEK	1	/73	
	DIGITAL INPUT REGISTER (5X8BIT PARALL INPUT GATES,5TH BYTE SETS L,TTL,1=H)	DO 200-2001	DORNIER	1	/71	
	(WITH FRONT PANEL CONNECTOR)	DO 200-2201		1	/72	
	(WITHOUT WIRING BOARD)	DO 200-2000		1	/73	
	DIGITAL INPUT REGISTER (5X8BIT PARALL INPUT GATES,5TH BYTE SETS L,HLL,1=H)	DO 200-2002	DORNIER	1	/72	
	(WITH FRONT PANEL CONNECTOR)	DO 200-2202		1	/72	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR

122 Storing Registers

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
C	DYNAMIC DIGITAL INPUT, POT. FREE	C 76451-A17-A3	SIEMENS	1	/73	(6)
	PARALLEL-INPUT-REGISTER (SINGLE 16/24BIT OPTION,READY SIGNALS,I/O TTL,ADC APPL)	MS PI 1 1230/1	AEG-TELEFUNKEN	1	/70	(1)
	PARALLEL-INPUT-REGISTER (SINGLE 16/24BIT OPT,READY SIGNALS,I/O TTL,CONTROL BUS)	MS PI 2 1230/1	AEG-TELEFUNKEN	1	/70	(1)
	PARALLEL INPUT REGISTER (1X16BIT, TTL)	2311	BI RA SYSTEMS	1	/73	
	PARALLEL INPUT REGISTER (16BIT,CONTINU-OUS OR STROBED MODES CONTROLLED BY REG)	7014-1	NUCL. ENTERPRISES	1	/70	
C	DYN. DIG. INPUT (16BIT, TTL, LAM IF INPUT 0-1 OR 1-0 OR BOTH)	C 76451-A17-A4	SIEMENS	1	/73	(6)
	INPUT REGISTER (24BIT, SPEC CONN, 8 BIT ALSO VIA LEMO,LAM ON NON-ZERO OR STROBE)	FHC 1308	BF VERTRIEB	1	/71	
	PARALLEL INPUT REGISTER (1X24BIT, TTL)	2321	BI RA SYSTEMS	1	/73	
	INPUT REGISTER 24-BIT	3470	KINETIC SYSTEMS	1	/71	(4)
	BALANCED INPUT REGISTER WITH ADDRESSING	3430	KINETIC SYSTEMS	1	/72	(8)
	PARALLEL INPUT REGISTER (2X16BIT, TTL)	2312	BI RA SYSTEMS	1	/73	
C	DUAL INPUT REGISTER(2X16BIT,LAM & STROBE I/P & DATA-READ-STROBE O/P PER CHANNEL)	PR 1610 SERIES	GEC-ELLIOTT	1	/73	
N	CAMAC UNTERM, I/P'S VIA SCHMITT TRIGGERS I/P FILTER RESPONSE 1USEC TO 10MS	PR 1611		1		
	32 BIT INPUT REGISTER	C 345	INFORMATEK	1	/73	
	DUAL 16 BIT INPUT REGISTER (TTL LEVELS, CERN SPECS 072)	2IR 2002	SEN	1	/72	
	DUAL 16 BIT INPUT REGISTER(EXT STROBE OR DATAWAY COMMAND STORES DATA,TTL LEVELS)	2IR 2010	SEN	1	/70	
C	DIGITAL INPUT (2X16BIT POT. FREE)	C 76451-A8-A3	SIEMENS	1	/73	(6)
	DUAL 24 BIT PARALLEL INPUT REGISTER(TTL)	2322	BI RA SYSTEMS	1	/73	
	DUAL 24 BIT PARALLEL INPUT REGISTER(TTL)	2322A	BI RA SYSTEMS	1	/73	
	DUAL 24 BIT INPUT REGISTER (TTL, HANDSHAKE)	RI-224	EG&G	1	/72	
C	DUAL INPUT REGISTER(2X24BIT,LAM & STROBE I/P & DATA-READ-STROBE O/P PER CHANNEL)	PR 2400 SERIES	GEC-ELLIOTT	1	/73	
N	CAMAC UNTERM, I/P'S VIA SCHMITT TRIGGERS I/P FILTER RESPONSE 1USEC TO 10MS	PR 2401		1	/73	
N	(SAME BUT WITH TWISTED PAIR INPUTS)	PR 2402		1	/73	
N	(SAME BUT WITH OPTICAL ISOLATION INPUT, LOGIC 1 = 5V OR 12MA)	PR 2403		1	/73	
	DUAL INPUT REGISTER (2X24BIT, INPUT INTEG TTL INPUT, +AND- LOGIC)	221	HYTEC	1	/73	
	DUAL PARALLEL INPUT REGISTER(2X24BIT,EXT LOAD REQUEST,4 OPER MODES,TTL LEVELS)	60	JORWAY	1	/70	
	24-BIT DUAL PARALLEL INPUT REGISTER (A HAS LO-Z, B HAS UNTERMINATED INPUT)	9041A/9041B	NUCL. ENTERPRISES	1	/72	(7)
	PARALLEL INPUT REGISTER (2X24 BITS)	J RE 10	SAIP/SCHLUMBERGER	1	/73	(7)
	DUAL 24 BIT PARALLEL INPUT REGISTER (WITH LED DISPLAY OPTION)	PR-604	STND ENGINEERING	1	/72	
	DUAL INPUT REGISTER (2X24BIT,INPUT INTEG TTL SCHMITT TRIG I/P, +AND- LOGIC)	220	HYTEC	1	/73	
	INPUT REGISTER (2X24BIT, HIGH IMPEDANCE I/P, LED DISPLAY, 2X6BIT O/P REG OPTION)	IR	JOERGER	1	/72	(7)
	DIGITAL INPUT REGISTER, EXTERNAL STROBE (4X8BIT INPUT LATCHES, 1X8BIT SET LAM)	DO 200-2004	DORNIER	1	/73	
	(SAME WITH FRONT PANEL CONNECTOR)	DO 200-2204		1	/73	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR

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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	COINCIDENCE LATCH (24 NIM INPUTS WITH COMMON STROBE, EXT RESET, 2NSEC OVERLAP)	C124	EG&G	2		
	12 BIT PARALLEL INPUT REGISTER (NIM)	2351	BI RA SYSTEMS	1	/73	
N	INTERRUPT REGISTER 12-INPUT & STROBE NIM FAST LOGIC LEVELS	IR026	EG&G	1	/73	
	STROBED INPUT REGISTER (12BIT COINC AND LATCH,NIM LEVELS,PATTERN AND L-REQ APPL)	SIR 2026	SEN	1	/70	
	FAST COINCIDENCE LATCH(16BIT,DISCR I/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 (STROBE I/P, 2NS OVERLAP,FAST SUM O/P AND CLEAR,NIM)	2341	LRS-LECROY	2	/71	(4)
	PATTERN UNIT (16 INDIV NIM INPUTS,COMMON NIM GATE)	021	NUCL. ENTERPRISES	2	/71	(5)
N	FAST INPUT REGISTER (ASSEMBLES 16BIT WORDS FROM IL2 INPUTS)	9053	NUCL. ENTERPRISES	1	06/74	
	PATTERN UNIT(16BIT,I/P STROBED WITH COMMON GATE,10 NSEC OVERLAP,NIM LEVELS)	C 101	RDT	2	/71	
	16 BIT PATTERN UNIT (NIM I/P AND GATE)	J PU 10	SAIP/SCHLUMBERGER	1	/72	
	PATTERN UNIT 16 BIT (16 INDIVIDUAL NIM INPUTS,COMMON NIM GATE, CERN SPECS 021)	16P 2007	SEN	2	/70	
	16 BIT PATTERN UNIT (CERN SPECS 071, 16 INDIVIDUAL NIM INPUTS,COMMON NIM GATE)	16P 2047	SEN	1	/72	(6)
	COINCIDENCE BUFFER (2X12BIT,ONE STROBE PER 12BITS,MIN 2NS OVERLAP,NIM INPUTS)	C212	EG&G	2	/71*	

124 Manual Input Modules (Word Generators, Parameter Units)

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

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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	24-BIT INTERRUPT REGISTER (STATUS COMPARED,CHANGE GIVES LAM)	1051	BORER	1	/72	(3)
	PRIORITY INPUT REGISTER(12BITS ORED TO LAM,FAST COINC LATCH APPL,NIM LEVELS)	63	JORWAY	2	/70	
	INTERRUPT REQUEST REGISTER (8BIT, TTL INPUTS TO REGISTER,ANY INPUT GIVES LAM,	7013-1	NUCL. ENTERPRISES	1	/70	
	INTERRUPT REQUEST REGISTER	EC 218	NUCL. ENTERPRISES	1		
C	LAM REQUEST REGISTER (16 BIT)	300	POLON	1	02/74	
N	64 LINE SURVEYOR	64LS 2052	SEN	1		(9)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR

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

131 Serial Output Modules (Clocks, Timers, Pulse GEN)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	PRESET SCALER (LEVEL OR PULSE TRAIN O/P, DURATION SET BY COMMAND,SINGLE & REPEAT)	PSR 0801	GEC-ELLIOTT	1	/73	
	TIMER MODULE	3655	KINETIC SYSTEMS	1	/73	
	CRYSTAL CLOCK GENERATOR (7 TTL OUTPUTS FOR 1HZ TO 1MHZ FREQUENCY DECADES)	FHC 1303	BF VERTRIEB	1	/71	(1)
	CRYSTAL CONTROLLED PULSE GENERATOR(7 DE-CADES-1HZ TO 1MHZ-500NS PULSES OUT,TTL)	PG 0001	GEC-ELLIOTT	1	/71	
	REAL TIME CLOCK (4SEC CLOCK/5MSEC STOP WATCH)	C 320	INFORMATEK	1	/72	
	CLOCK GENERATOR (INT 10MHZ, EXT 50MHZ, 8 DECADE STEPS,PLUS PROGRAMMABLE OUTPUT)	CG	JOERGER	1	/72	(7)
	CLOCK PULSE GENERATOR (7 OUTPUTS-1HZ TO 1MHZ-IN DECADE STEPS,10MHZ EXT IN,TTL)	7019-1	NUCL. ENTERPRISES	1	/70	
	CLOCK PULSE GENERATOR(7 DECADES-1HZ TO 1MHZ-500 NSEC PULSES OUT,TTL AND NIM)	C 109	RDT	1	/71	
	1 HZ - 1 MHZ QUARTZ CLOCK (7 O/P - 1HZ TO 1MHZ-200 TO 800 NSEC WIDTH,TTL LEVEL)	J HQ 10	SAIP/SCHLUMBERGER	1	/71	
C	QUARZ-CLOCK WITH 2 TIMER FUNCTIONS	C 76451-A14-A1	SIEMENS	1	/72	
	CAMAC-CLOCK-GENERATOR(7 DECADES-10MHZ TO 1HZ,50/500 NSEC O/P PULSES,2.8V/50 OHMS)	C-CG-10	WENZEL ELEKTRONIK	1	/71	
	CLOCK/TIMER (0.001S TO 10 HRS TIME INTERVAL,REAL-TIME OUTPUT)	1411	BORER	1	/72	(3)
N	REAL TIME CLOCK, LIVE TIME INTEGRATOR, PRESET TIMER	RC014	EG&G	1	/73	
	REAL TIME CLOCK (COUNTS .1 SEC TO 999 DAYS, DISPLAYS HRS/MIN/SEC, 50/60HZ GEN)	RTC	JOERGER	2	/73	(7)
	REAL TIME CLOCK (3.8 USEC TO 18.2 HRS, PRESET-TIME AND PRESET-COUNT MODES)	RTC 2014	SEN	1	/71	
	TIME BASE (10 TO 100MHZ IN INCREMENTS OF 10MHZ, USED WITH TD 2031/TD 2041)	TB 2032	SEN	1	/71	
C	TIMER (MIN 1USEC,OVF FROM COUNTER-PP1)	C 76451-A12-A1	SIEMENS	2	/73	(6)
	TEST PULSE GENERATOR (5 TO 50 NSEC NIM O/P PULSE DERIVED FROM S1.F(25) OR EXT)	TPG 0202	GEC-ELLIOTT	1	/71	
	DUAL PROGRAMMED PULSE GENERATOR(50HZ/2KHZ/5MHZ PULSE TRAIN,LENGTH BY COMMAND)	2PPG 2016	SEN	1	/71	

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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	12 BIT PARALLEL OUTPUT REGISTER (NIM)	3251	BI RA SYSTEMS	1	/73	
N	NIM FAST LOGIC DRIVER (12 OUTPUTS)	ND027	EG&G	1	/73	
	12 BIT OUTPUT REGISTER(DC OR PULSE O/P, UPDATING STROBE OUTPUT,NIM LEVELS)	41	JORWAY	1	/71	(2)
	OUTPUT REGISTER (12BIT, NIM PULSES OR LEVELS OUT)	OR 2027	SEN	1	/70	
	16 BIT PARALLEL OUTPUT REGISTER (TTL)	3211	BI RA SYSTEMS	1	/73	
	DIFFERENTIAL OUTPUT REGISTER	3030	KINETIC SYSTEMS	1	/72	(8)
	OUTPUT REGISTER (24BIT TTL VIA SPEC CONN 8BIT ALSO VIA FRONT PANEL LEMO)	FHC 1309	BF VERTRIEB	1	/72	
	24 BIT OUTPUT REGISTER (TTL)	3221	BI RA SYSTEMS	1	/73	
C	OUTPUT REGISTER	351	POLON	1	/73	
C	PARALLEL OUTPUT REGISTER (24BIT, TTL)	C-OC-24	WENZEL ELEKTRONIK	1	/72	
	DUAL 16BIT PARALLEL OUTPUT REGISTER(TTL)	3212	BI RT SYSTEMS	1	/73	
N	DUAL OUTPUT REGISTER (30 TTL LOADS)	2OR 2051	SEN	1		(9)
	OUTPUT REGISTER (2X16BIT VIA ISOLATING CONTACTS)	1082	BORER	1	/72	(4)
	DUAL 24 BIT PARALLEL OUTPUT REGISTER	3222	BI RA SYSTEMS	1	/73	
	OUTPUT REGISTER (2X24BIT DATA OUT,DATA-READY + BUSY FORM HANDSHAKE, TTL)	RO-224	EG&G	1	/72	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	OUTPUT REGISTER (2X24BIT OR 6X8BIT, LED DISPLAY)	OR	JOERGER	1	/72	(7)
	24-BIT DUAL OUTPUT REGISTER	9042	NUCL. ENTERPRISES	1	/72	(7)
	DUAL OUTPUT REGISTER (2X24BIT, DATAWAY READ AND WRITE, HANDSHAKE CONTROL, LO-Z)	9043A	NUCL. ENTERPRISES	1		(7)
	DUAL OUTPUT REGISTER (2X24BIT, DATAWAY READ AND WRITE, HANDSHAKE CONTROL, HI-Z)	9043B		1		(7)
	PARALLEL OUTPUT REGISTER (2X24 BITS)	J RS 10	SAIP/SCHLUMBERGER	1	/73	(7)
	DUAL 24 BIT PARALLEL OUTPUT REGISTER (WITH LED DISPLAY OPTION)	PR-612	STND ENGINEERING	1	/71	(6)
	DIGITAL OUTPUT REGISTER (4X8BIT PARALL OUTPUT REGISTER,NO L,TTL,1=H)	DO 200-2501	DORNIER	1	/71	
	(WITH FRONT PANEL CONNECTOR)	DO 200-2701		1	/72	
	(WITHOUT WIRING BOARD)	DO 200-2500		1	/73	
	DIGITAL OUTPUT REGISTER (4X8BIT PARALL OUPTPUT REGISTER, HLL 12V)	DO 200-2505	DORNIER	1	/73	
	(WITH FRONT PANEL CONNECTOR)	DO 200-2705		1	/73	
	DIGITAL OUTPUT REGISTER (4X8BIT PARALL OUPTPUT REGISTER, HLL 12V,INVERTING)	DO 200-2506		1	/73	
	(WITH FRONT PANEL CONNECTOR)	DO 200-2706		1	/73	
	DIGITAL OUTPUT REGISTER (4X8BIT PARALL OUPTPUT REGISTER, HLL 24V)	DO 200-2507		1	/73	
	(WITH FRONT PANEL CONNECTOR)	DO 200-2707		1	/73	
	DIGITAL OUTPUT REGISTER (4X8BIT PARALL OUPTPUT REGISTER, HLL 24V, INVERTING)	DO 200-2508		1	/73	
	(WITH FRONT PANEL CONNECTOR)	DO 200-2708		1	/73	
	OUTPUT REGISTER (32X16BIT, EX. ADDRESS)	101	HYTEC	1		
	128 BIT OUTPUT REGISTER (ADDRESSABLE AS 8 16BIT OR 128 1-BIT WORDS)	C 342	INFORMATEK	1	/73	
	OUTPUT REGISTER (32X24BIT, EX. ADDRESS)	104	HYTEC	1		
	OUTPUT REGISTER (16X24BIT, EX. ADDRESS)	105		1		
	OUTPUT REGISTER (256X24BIT, EX ADDRESS)	111		1	/73	

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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	12-BIT OUTPUT REGISTER (WITH OPTICAL ISOLATION,OPEN COLL O/P, MAX 30V/100MA)	3082	KINETIC SYSTEMS	1		
	12-BIT OUTPUT REGISTER WITH ISOLATED RELAY	3087	KINETIC SYSTEMS	1	/71	(4)
	8 BIT TRIAC OUTPUT REGISTER	3080	KINETIC SYSTEMS	1	/73	
	SWITCH (12BIT DATAWAY CONTROLLED RELAY REGISTER FOR SWITCHING AND MULTIPLEXING)	7066-1	NUCL. ENTERPRISES	1	/71	
	DRIVER (16BIT,OPEN COLLECTOR OUTPUT VIA MULTIWAY CONNECTOR,MAX 150MA/LINE)	9002	NUCL. ENTERPRISES	1	/71	
C	OUTPUT REGISTER (16BIT WORD, 24V/.1A OUTPUT VIA 25-WAY CONNECTOR)	360	POLON	1	/73	
	RELAY DRIVER (16 WAY RELAY OUTPUT)	J RD 10	SAIP/SCHLUMBERGER	1	/73	(8)
C	PARALLEL OUTPUT REGISTER (16 BIT REED RELAY)	C-OR-16	WENZEL ELEKTRONIK	1	/72	
	DRIVER (24BIT OUTPUT REGISTER,SET AND READ BY COMMAND,24BIT I/P DATA ACCEPTED)	9013	NUCL. ENTERPRISES	1	/71	
	DRIVER (24BIT OUTPUT REGISTER,SET AND READ BY COMMAND,24BIT I/P DATA ACCEPTED)	9017	NUCL. ENTERPRISES	1	/71	(1)
C	OUTPUT DRIVER(2X16BIT,40MA SINKING,1=LO, DATAWAY READ & WRITE,LAM I/P,STROBE O/P)	OD 1613	GEC-ELLIOTT	1	/72	
	(SAME, 1=HI)	OD 1614		1	/72	
C	OUTPUT DRIVER(2X16BIT,125MA SINKING,1=LO DATAWAY READ & WRITE,LAM I/P,STROBE O/P)	OD 1617	GEC-ELLIOTT	1	/72	
	(SAME, 1=HI)	OD 1618		1	/72	
C	OUTPUT DRIVER(2X16BIT,TOTEMPOLE,30 LOADS DATAWAY READ & WRITE,LAM I/P,STROBE O/P)	OD 1620	GEC-ELLIOTT	1	/72	
	DUAL 16 BIT OUTPUT REGISTER (TTL LEVELS, OPEN COLL OUTPUTS VIA CABLE)	2OR 2008	SEN	1	/70	
N	DUAL OUTPUT DRIVER (200MA SINKING,24V)	2OR 2051HC	SEN	1		(9)
N	DUAL OUTPUT DRIVER (HI VOLTAGE DRIVER)	2OR 2052HV	SEN	1		(9)
C	DIGITAL OUTPUT (2X16BIT, MAX 30V)	C 76451-A9-A4	SIEMENS	1	/73	(6)
C	DIGITAL OUTPUT (2X16BIT RELAYS)	C 76451-A9-A3	SIEMENS	1	/73	(6)
	PARALLEL-OUTPUT-REGISTER (DUAL 24BIT, OR QUAD 12BIT,OPEN COLLECTOR OUTPUT)	MS PO 1 1230/1	AEG-TELEFUNKEN	1	/70	(1)
	PARALLEL-OUTPUT REGISTER (24BIT, OPEN COLLECTOR OUTPUT, HANDSHAKE FACILITY)	MS PO 2 1230/1	AEG-TELEFUNKEN	1	/72	(4)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
C	OUTPUT DRIVER(2X24BIT,40MA SINKING,1=LO, DATAWAY READ & WRITE,LAM I/P,STROBE O/P)	OD 2403	GEC-ELLIOTT	1	/72	
	(SAME, 1=HI)	OD 2404		1	/72	
C	OUTPUT DRIVER(2X16BIT,125MA SINKING,1=LO DATAWAY READ & WRITE,LAM I/P,STROBE O/P)	OD 2407	GEC-ELLIOTT	1	/72	
	(SAME, 1=HI)	OD 2408		1	/72	
C	OUTPUT DRIVER(2X16BIT,TOTEMPOLE,30 LOADS DATAWAY READ & WRITE,LAM I/P,STROBE O/P)	OD 2410	GEC-ELLIOTT	1	/72	
	DUAL OUTPUT REGISTER (2X24BIT, OPEN COLL OUTPUTS, 150MA/50V, DATAWAY READ)	200	HYTEC	1	/73	
	OUTPUT REGISTER (2X24BIT OR 6X8BIT, 250MA SINKING, DIODE CLAMPED)	OR-1	JOERGER	1	/73	
	DUAL 24 BIT OUTPUT REGISTER(DC OR PULSE O/P,UPDATING O/P STROBE,TTL OPEN COLL)	40	JORWAY	1	/71	(2)
	DUAL 24-BIT OUTPUT REGISTER (OPEN COLL DRIVERS, MAX 24V OR 250MA, REAR OUTPUTS)	3072	KINETIC SYSTEMS	1		
	DIGITAL OUTPUT REGISTER (4X8BIT PARALL OUTPUT REGISTER,NO L,OPEN COLL O/P,1=H)	DO 200-2502	DORNIER	1	/72	
	(WITH FRONT PANEL CONNECTOR)	DO 200-2702		1	/72	
	DIGITAL OUTPUT REGISTER (4X8BIT PARALL OUTPUT REGISTER,NO L,OPEN COLL O/P,1=L)	DO 200-2503	DORNIER	1	/72	
	(WITH FRONT PANEL CONNECTOR)	DO 200-2703		1	/72	
	DIGITAL OUTPUT REGISTER WITH REED RELAYS (4X8BIT OUTPUT REG,OPEN CONTACT=0)	DO 200-2504	DORNIER	1	/71	
	(WITH FRONT PANEL CONNECTOR)	DO 200-2704		1	/71	

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

142 Parallel I/O Registers (General Purpose)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	PARALLEL I/O REGISTER (32X24BIT)	100	HYTEC	1		
	PARALLEL I/O REGISTER (32X16BIT)	101		1	/72	
	PARALLEL I/O REGISTER (16X24BIT)	102		1	/72	
	PARALLEL I/O REGISTER (256X24BIT)	112		1	/73	
	DUAL INPUT DUAL OUTPUT REGISTER (16BIT, TTL IN, OPEN COLL TTL OUT, MAX 40MA,30V)	C110	RDT	1	/72	
	INPUT/OUTPUT REGISTER (2X24BIT IN,2X6BIT O/P, HI-Z INPUT, LED DISPLAY)	IR-1	JOERGER	1	/72	(7)

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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	DESK CALCULATOR CTRL (DIEHL INTERFACE TO FHC 1301/02/11 AND FHC 1309)	FHC 1312	BF VERTRIEB	1	/72	
	TYPEWRITER DRIVE UNIT	TD 0801	GEC-ELLIOTT	2	/73	(1)
	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	2	/71	
	TELETYPEWRITER INTERFACE(I/O DATA TRANSF AND CONTROL,LAM USED AS TWO-WAY FLAG)	7061-1	NUCL. ENTERPRISES	1	/70	(1)
C	TELETYPE INTERFACE (FOR ASR 33)	500	POLON	1	02/74	
	TELETYPE DRIVER	J TY 10	SAIP/SCHLUMBERGER	1	/73	(8)
	TELETYPE INTERFACE	C-T-33	WENZEL ELEKTRONIK	1	/72	
	VERSATEC LINE PRINTER INTERFACE	3320	KINETIC SYSTEMS	1	/72	
	PAPER TAPE PUNCH OUTPUT DRIVER (FOR FACIT 4070)	TP 0801	GEC-ELLIOTT	1	/73	(1)
	TAPE READER INTERFACE UNIT (FOR ELECTROGRAPHIC READER)	TR 0801	GEC-ELLIOTT	1	/73	(1)
N	MAG TAPE DRIVER(9-TRACK NRZI COMPATIBLE)		EDS SYSTEMTECHNIK	0		
	MAGNETIC TAPE INTERFACE (TAPE DECKS OR CASSETTES)	CS 0042	NUCL. ENTERPRISES	1	/73	(8)
	UNIVERSAL ASYNCHRONOUS TRANSMITTER/RECEIVER (129 CHAR.BUFFER)	C 317	INFORMATEK	1	/73	
	B.S.INTERFACE READER (8BIT DATA + PARITY BIT,BRITISH STANDARD)	7057-1	NUCL. ENTERPRISES	1	/71	
	B.S.INTERFACE DRIVER (8BIT DATA + PARITY BIT,BRITISH STANDARD)	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)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	PERIPHERAL DRIVER (8BIT DATA OUT,NEG OR POS TTL,HANDSHAKE CONTROLS)	7065-1	NUCL. ENTERPRISES	1	/71	(1)

144 Display Modules, Display and Plotter Interfacing

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	24 BIT LED BCD DISPLAY (ONE FHC 1301/02/11 VIA SPEC CONNECTOR)	FHC 1305	BF VERTRIEB	1	/71	(1)
	24 BIT NIXIE BCD DISPLAY (SELECTS ONE OF 10 FHC 1301/02/11 VIA SPEC CONNECTION)	FHC 1306	BF VERTRIEB	2	/71	(1)
	24 BIT LED BINARY DISPLAY (ONE FHC 1313 OR FHC 1309 VIA SPECIAL CONNECTION)	FHC 1315	BF VERTRIEB	1	/72	
	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	
	SCALER DISPLAY THROUGH COMPUTER (DISPLAY OF 24BIT WORD)	J AF 15	SAIP/SCHLUMBERGER	2	/71	
	MANUAL BINARY DISPLAY (CONTENT OF A REGISTER DISPLAYED,EXT MULTIWAY CONN)	J AF 20	SAIP/SCHLUMBERGER	1	/71	
	EXTERNAL DISPLAY FOR J EA 10 SCALER	C AE 10	SAIP/SCHLUMBERGER	NA	/73	
C	GRAPHIC DISPLAY DRIVER FOR HP1311/TEK602	4301	BI RA SYSTEMS	2	01/74	
N	TV DISPLAY DRIVER (12 LINES,40 CHAR/LINE 64 CHARACTER SET, 5X7 DOT MATRIX)		EDS SYSTEMTECHNIK	0	/73	
N	TERMINAL MODULE (24 LINES, 80 CHAR/LINE)		EDS SYSTEMTECHNIK	0	/73	
N	DISPLAY POINT PLOTTER (1024X1024 CAPACITY)	PP012	EG&G	1	/73	
N	DISPLAY DRIVER (INTERFACE FOR TEKTRONIX STORAGE OSCILLOSCOPES)	DD015		1	/73	
N	CHARACTER GENERATOR (63 CHARACTERS, 7X5 DOTMATRIX, 2 SIZES)	CG018		1	/73	
N	DISPLAY VECTOR GENERATOR	VG028		1	/73	
	DISPLAY DRIVER (POINTPLOT CHAR GEN AND VECTOR GENERATOR)	DD 1601	GEC-ELLIOTT	2	/73	(7)
	MEMORY OSCILLOSCOPE DISPLAY (VECTOR, CHARACTER AND HISTOGRAM GEN)	C 311	INFORMATEK	2	/73	
	CRT DECIMAL DISPLAY SYSTEM (INCLUDING)	72A	JORWAY	NA	/71	(2)
	DISPLAY DRIVER	72A		5		
	DISPLAY SYSTEM COMPRISING		KINETIC SYSTEMS		/71	(4)
	DISPLAY SYNCHRONIZING	3200		1	/71	
	DISPLAY TIMING	3205		1	/71	
	DISPLAY CONTROL	3210		1	/71	
	DISPLAY REFRESH (ALPHANUMERIC + GRAPHS)	3212		1	/71	
	DUAL LIGHT PEN INTERFACE	3225		1	/72	
	COLOR MONITOR	RGB 1200 M			/71	
	STORAGE DISPLAY DRIVER	3260	KINETIC SYSTEMS	1	/72	
	DISPLAY DRIVER (TWO 10BIT DAC,OUTPUT RANGE +5V TO -5V,TWO OPERATION MODES)	7011-2	NUCL. ENTERPRISES	2	/70	(1)
	STORAGE OSCILLOSCOPE (DRIVER FOR TEKTRONIX 611 OR 601,USED WITH 7011)	9028	NUCL. ENTERPRISES	1	/71	(2)
	SCOPE DISPLAY DRIVER	J DD 10	SAIP/SCHLUMBERGER	2	/73	(7)
	MANUAL CONTROL OF J DD 10	MC 10		NA		
	SCOPE DISPLAY DRIVER X-Y-Z (SYSTEM)	FDD 2012	SEN	1	/71	(1)
	STORAGE DISPLAY DRIVER FOR TEKTRONIX 611 OR 601	SDD 2015		1	/71	(1)
	CHARACTER GENERATOR	CG 2018		1	/71	(1)
	VECTOR GENERATOR	VG 2028		1	/71	(1)
	LIGHT PEN FOR FDD 2012 OR CG 2018	LP 2035			/71	
	RECORDER DRIVER	J XY 10	SAIP/SCHLUMBERGER	1	/73	(8)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR

145 Instrumentation Interfacing Modules (DVM, Suply CTR, Stepping Motor Drivers, Pulse Analyser CTR)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	DUAL 15 CHANNEL SERIAL OUTPUT MODULE (STEPPER MOTOR CONTROLLER, TTL)	3101	BI RA SYSTEMS	2	/73	
	(SAME, RELAY OUTPUTS)	3102		2	/73	
	DUAL 8 CHANNEL SERIAL OUTPUT MODULE (STEPPER MOTOR CONTROLLER, TTL)	3106		2	/73	
	(SAME, RELAY OUTPUTS)	3107		2	/73	
	STEP MOTOR DRIVER (MAX 32768 STEPS,RATE, ROTATION AND START/STOP FULLY COMMANDED)	1161	BORER	1	/72	(3)
	STEPPING MOTOR CONTROLLER, DUAL	3360	KINETIC SYSTEMS	1	/72	(4)
	STEPPING MOTOR CONTROLLER	3361	KINETIC SYSTEMS	1	/73	
	STEPPING MOTOR DRIVER (USED WITH 7045)	0709	NUCL. ENTERPRISES	1	/71	
	DELAYED PULSE GENERATOR (4 TTL O/P,0.042 HZ-40KHZ RATE,LEVEL AND DIRECTION CONTR)	7045-1	NUCL. ENTERPRISES	1	/70	
C	STEPPING MOTOR DRIVER	J CP 20	SAIP/SCHLUMBERGER	1	/74	(9)
	STEPPER CONTROLLER (CONTINUOUS)	C-ST-4	WENZEL ELEKTRONIK	2	/72	
	STEPPER CONTROLLER - INCREMENTAL MOTOR	C-ST-4-I	WENZEL ELEKTRONIK	2	/72	
	POWER SUPPLY CONTROLLER 12-BIT	3158	KINETIC SYSTEMS	1	/73	
	CAMAC-TO-SCIPP PHA INTERFACE	2323	BI RA SYSTEMS	2	/73	
	INTERFACE CAMAC-TO-LABEN 8000SERIES MULTICHANNEL ANALYZERS	5380	LABEN	3		
	MULTICHANNEL ANALYZER - CAMAC INTERFACE (FOR PACKARD 9000 AND 900 SERIES MCA)	9701	PACKARD	3		(4)
	CAMAC INTERFACE FOR CA25/CA13/C97 ADC	J CCA 10	SAIP/SCHLUMBERGER	2	/71	
N	SYNCHRO TO DIGITAL CONVERTER (SINGLE AND MULTI-TURN CAPABILITIES)	SDC	JOERGER	2	/73	
	DUAL SYNCHRO-DIGITAL CONVERTER (14BIT)	CS 0047	NUCL. ENTERPRISES	2	/73	
	DUAL INCREMENTAL POSITION ENCODER (2X20 BIT X-Y DIGITIZATION BY UP-DOWN COUNTER)	2IPE 2019	SEN	1	/71	
N	INTERFACE FOR MEASURING DEVICES (DUAL INPUT FOR 2 INSTRUMENTS)	DO 200-1411	DORNIER	1	02/74	
	OUTPUT REGISTER (16 OR 24 BIT TTL DRIVER FOR FAST-ROUTING MULTIPLEXER SYSTEM)	CM 665	J AND P	1	/71	
N	PULSE DURATION DEMODULATOR	3720	KINETIC SYSTEMS	1	/73	
	CAMAC-TO-MODULAR 15 INTERFACE UNIT (INTERFACING IN-HOUSE A-D EQUIPMENT)	MC 5201	MICRO CONSULTANTS	1	/71	(2)
	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)
	PLUMBICON READ OUT (5 SCALERS RECORD DIGITIZED OUTPUTS FROM PLUMBICON CAMERA)	J PM 10/PLUM	SAIP/SCHLUMBERGER	1	/71	(6)
	PLUMBICON READ OUT TERMINAL	J PG 10/PUDDING		1	/71	(6)
N	CONTROLLER-INTERFACE FOR DIGITAL PROCESSING SCOPE AND TRANSIENT DIGITIZER	APD/R7912	TEKTRONIX	2	/74	
C	ADC/CAMAC INTERFACE (FOR ANY ADC,2X16BIT O/P BUFFER,STATUS,LAM HANDL,CLOCK TIME)	C-A1-2	WENZEL ELEKTRONIK	1	/72	

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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	START-STOP CONTROLLER(START,STOP,RESET, MANUAL OR DATAWAY CONTROL, 100HZ CLOCK)	FHC 1304	BF VERTRIEB	1	/71	(1)
N	CAMAC DATA LINK MODULE (16 BIT PARALLEL,ASYNCHRONOUS DATA LINK)	6701	BI RA SYSTEMS	2	/73	
	COMMUNICATION INTERFACE (V24/V23/V21 MODEM INTERFACE WITH AUTO-DIAL OPTION)	DO 200-2911	DORNIER	1	/73	
N	BIT-SYNCHRONIZER - CAMAC PROGRAMABLE 0 TO 10V INPUT, PCM-SIGNAL IN SERIES	DO 200-2250	DORNIER	3	/73	
N	(SAME BUT HARDWARE PROGRAMABLE)	DO 200-2251		3	/73	
N	FORMAT-SYNCHRONIZER, IDENTIFICATION AND OUTPUT OF DIGITAL DATA WORDS	DO 200-2260	DORNIER	4	/73	
N	(SAME BUT HARDWARE PROGRAMABLE)	DO 200-2261		4	/73	
N	MODEM INTERFACE WITH AWD OPTION	DO 200-2912	DORNIER	1	02/74	
N	CONTROLLED TIMER (BUSY-DONE LOGIC)	CT021	EG&G	1	/73	
	SENSOR (INTER. UP TO 65.000 GROUPS OF 16/32 BITS, READS PATTERNS OR ADDRESSES)	C 347	INFORMATEK	1	/73	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	SERIAL INTERFACE (V24 SPEC)	9045	NUCL. ENTERPRISES	1	/73	
	START-STOP UNIT (START, STOP CLOCK AND GATE OUTPUTS)	J AM 10	SAIP/SCHLUMBERGER	1	/71	
	FOUR FOLD BUSY DONE (START SIGNAL INITIATED BY COMMAND,DEVICE RETURNS LAM)	4BD 2021	SEN	1	/71	

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

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

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

152 Digital Level Converters

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

153 Code Converters

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	DECIMAL INPUT 6 NUMBERS 3 DIGITS CODE CONVERTER	DO 200-2005	DORNIER	32	03/74	
N	(SAME BUT 3 NUMBERS)	DO 200-2006	DORNIER	2	03/74	
	CAMAC BCD-TO-BINARY CONVERTER	LEM-52/5,7	EISENMANN	1		
	CAMAC BINARY-TO-BCD CONVERTER WITH DECIMAL DISPLAY	LEM-52/5,8	EISENMANN	1		
	BINARY CODE CONVERTER(BIN-BCD OR BCD-BIN CONVERSION, DATA FROM DATAWAY OR FRONT)	9044	NUCL. ENTERPRISES	1		(7)
C	BINARY TO DECIMAL CODE CONVERTER (24 BIT BINARY TO 8 DECADE)	610	POLON	1	04/74	
	BINARY TO BCD-CONVERTER(24BIT TO 8 DECADE,DISPLAY,CONV 4USEC,TTL LEVEL OUT,1=H)	C-BBC-24	WENZEL ELEKTRONIK	2	/71	

154 Buffer Memories, Storage Units

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	OUTPUT REGISTER (256X24BIT, RAM + 32X24	110	HYTEC	1		
	OUTPUT REGISTER (256X24BIT, RAM + 64X24 BIT ROM, EX ADDR , FOR USE WITH 7025-2)	110A		1		
	A/D, 12BIT BCD, 16 WAY MULTIPLEXER, 16X24BIT STORE, 100USEC/CHANNEL UPDATE)	500	HYTEC	1	/73	
	CAMAC 16 WORD 24 BIT MEMORY	MC 5202	MICRO CONSULTANTS	2	/72	(6)
	16 WORD STORE	CS 0003	NUCL. ENTERPRISES	1		(4)
	256 WORDS OF 24 BIT STORE MODULE	CS 0015	NUCL. ENTERPRISES	1	/72	(7)
	BUFFER MEMORY (256 16BIT WORDS, USE WITH J CAN 21/C/H)	J MT 20	SAIP/SCHLUMBERGER	1	/72	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	155 Logic and Arithmetic Processing Modules					
	FLOATING POINT ARITHMETIC INTERFACE (FOR USE WITH M 128 HARD. FLOAT. POINT)	C 327	INFORMATEK	1	/73	
	16 Analogue Modules — ADC, DAC, Multiplexers, Amplifiers, Linear Gates, Discriminators etc.					
	161 Analogue Input Modules (DC and Pulse ADC, TDC)					
C	32 CHANNEL ANALOG DATA SYSTEM (EXPANDABLE WITH ADDITIONAL MUX MODULES)	5301	BI RA SYSTEMS	1	01/74	
	ANALOG INPUT (DUAL SLOPE ADC, +/-10V RANGE,14BITS/10V+SIGN,0.2SEC CONVERSION)	DO 200-1021	DORNIER	1	/72	
N	DUAL DIGITAL VOLTMETER (2X10BIT, DIFF INPUT, +100MV TO -100MV)	DV013	EG&G	1	/73	
	ANALOGUE TO DIGITAL INTEFACE (WITH PLUG-IN CONVERTER CARDS ADC/8Q, ADC/10Q AND ADC/12Q FOR 8, 10 AND 12 BIT CONVERSION)	ADC 1201	GEC-ELLIOTT	1	/71	(1)
C	INTEGRATING ADC (12BIT, RANGES 0 TO +5V, 0 TO -5V, 40MSEC CONVERSION TIME)	700	POLON	1	/73	
	VOLTAGE - FREQUENCY CONVERTER (USED WITH MULTIPLEXERS J MX 10/20)	J CTF 10	SAIP/SCHLUMBERGER	2	/73	
	UP-DOWN SCALER/FREQUENCY METER	J EF 10		1	/73	
	DUAL DIGITAL VOLTMETER (+AND- 0.1V, 10 BIT, DIFFERENTIAL INPUT)	2DVM 2013	SEN	1	/71	
C	DIG. VOLTMETER (12BIT + SIGN, POT-FREE RANGES--AC/DC .02V - 20V,DC 5-100MA)	C 76451-A13-A1	SIEMENS	2	/73	
	DIGITAL VOLTMETER (SAME AS TYPE C 76451-A13-A1 WITH DISPLAY)	C 76451-A13-A2	SIEMENS	2	/73	
	ANALOG INPUTS (MULTIPLEXER-ADC, 8 DIFF I/P,+/-10V RANGE,7BITS/10V+SIGN)	DO 200-1013	DORNIER	2	/72	
	ANALOG INPUTS (MULTIPLEXER-ADC, TO ONE ADC,+/-5V RANGE,7BITS/ 5V+SIGN)	DO 200-1016	DORNIER	2	/72	
	ANALOG INPUTS (MULTIPLEXER-ADC, 8 DIFF I/P, +10V RANGE,8BITS/10V)	DO 200-1019	DORNIER	2	/72	
	ANALOG INPUT (ADC, +/-10V RANGE, 7BITS/10V+SIGN)	DO 200-1027	DORNIER	2	/72	
	(SAME FOR +/-5V RANGE, 7BITS/5V +SIGN)	DO 200-1028		2	/72	
	(SAME FOR +10V RANGE, 8BITS/10V)	DO 200-1029		2	/72	
	ANALOGUE TO DIGITAL CONVERTER(8BIT, I/P RANGE 0 TO +5V OR 0 TO -5V,25 USEC CONV)	7028-1	NUCL. ENTERPRISES	1	/70	
	DUAL 10 BIT A/D	5304	BI RA SYSTEMS	1	/73	
C	SUCCESS. APPROX. ADC (WITH S+H, +/-5V OR 0 TO +/-10V, 12-BIT,23/13 USEC ACCESS)	1244/1244A	BORER	2	/73	(9)
	DUAL 10 BIT ANALOG TO DIGITAL CONVERTER	3515	KINETIC SYSTEMS	1	/73	
	DUAL SLOPE ADC (+AND- 0.01/1/10V RANGES, 11BIT RESOLUTION,20MS CONV TIME)	1241	BORER	2	/72	(3)
C	SUCCESS. APPROX. ADC (WITH S+H, +/-5V OR 0 TO +/-10V, 10-BIT,20/11 USEC ACCESS)	1243/1243A	BORER	2	/72	(9)
	ANALOG INPUTS (MULTIPLEXER-ADC, 8 DIFF I/P,+/-10V RANGE,11BITS/10V+SIGN)	DO 200-1003	DORNIER	2	/72	
	ANALOG INPUTS (MULTIPLEXER-ADC, 8 DIFF I/P,+/-5V RANGE,11BITS/ 5V+SIGN)	DO 200-1006	DORNIER	2	/72	
	ANALOG INPUTS (MULTIPLEXER-ADC, 8 DIFF I/P, +10V RANGE, 12BITS/10V)	DO 200-1009	DORNIER	2	/72	
	ANALOG INPUT (ADC, +/-10V RANGE, 11BITS/10V+SIGN)	DO 200-1024	DORNIER	2	/72	
	(SAME FOR +/-5V RANGE,11BITS/ 5V+SIGN)	DO 200-1025		2	/72	
	(SAME FOR +10V RANGE,12BITS/10V)	DO 200-1026		2	/72	
	A/D, 12BIT BCD, 16 WAY MULTIPLEXER, 16X24BIT STORE, 100USEC/CHANNEL UPDATE)	500	HYTEC	1	/73	
	A/D CONVERTER (12BIT,MAX 20 USEC CONVERSION, +AND-5V, +AND-10V, +10V RANGES)	30	JORWAY	2	/71	(2)
	DUAL 12 BIT ANALOG TO DIGITAL CONVERTER	3520	KINETIC SYSTEMS	1	/73	
	ANALOGUE TO DIGITAL CONVERTER (12BIT, 20 MSEC CONVERSION,RANGE -5V TO +5V)	7055-1	NUCL. ENTERPRISES	1	/70	
C	OCTAL CHARGE DIGITIZER (8X8BIT CHARGE SENSITIVE ADC, READOUT IN 4X16BIT WORDS)	QD808	EG&G	1		(7)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	QUAD FAST GATED INTEGRATOR (CHARGE DIGITIZER, 4X10 BIT)	QD410	EG&G	1	02/74	
	MULTI-MODE LINEAR ADC (8BIT,40MHZ CLOCK, AREA AND PEAK MODES,NIM LEVELS)	2243A	LRS-LECROY	1	/70	(2)
	OCTAL ADC (8 FAST I/P,8BIT/CH, COMMON GATE, NIM LEVELS, BILINEAR MODE)	2248	LRS-LECROY	1	/71	
N	12-CHANNEL ADC (12 FAST I/P, 10BIT/CH, <50USEC CONV, COMMON GATE, NIM LEVELS)	2249	LRS-LECROY	1	01/74	(9)
	OCTAL ADC (MIN 5 NSEC PULSES, POS OR NEG 8BIT/100 PC RESOLUTION, 250 USEC CONV)	9040	NUCL. ENTERPRISES	1	/72	(4)
N	ANALOGUE TO DIGITAL CONVERTER (80MHZ, 12 BITS)	9060	NUCL. ENTERPRISES	1	06/74	
	ADC - MEMORY INTERFACE (FOR J CAN 20/21 AND BM 96)	J CAN 20 I	SAIP/SCHLUMBERGER	2	/71	
	16,000 CHANNEL PULSE ADC (200MHZ CLOCK)	J CAN 21 C/H	SAIP/SCHLUMBERGER	6	/72	(6)
	1024 CHANNEL PULSE ADC (100MHZ CLOCK)	J CAN 40	SAIP/SCHLUMBERGER	2	/72	(6)
	QUAD CAMAC SCALER (4X16BIT OR 2X32BIT, 40MHZ)	1004	BORER	1	/72	
	TIME DIGITIZER (4X16BIT,50MHZ CLOCK,WITH CENTRE FINDER, USABLE WITH PRE-AMP 511)	1005	BORER	1	/72	
	TIME DIGITIZER (4 NIM STOP CHANNELS, COMMON START, 200 PSECS RESOLUTION)	TD104	EG&G	1		(7)
N	QUAD TIME DIGITIZER (SPARK CHAMBER READOUT, CENTER FINDING LOGIC)	TD031	EG&G	1	/73	
	QUAD TIME-TO-DIGITAL CONVERTER(9BIT/CH, 102/510NSEC RANGES,13USEC CONVERS,NIM)	2226A	LRS-LECROY	1	/70	(2)
N	OCTAL TIME-TO-DIGITAL CONVERTER(10BIT/CH 102/204NSEC RANGES, <50USEC CONVERSION)	2228	LRS-LECROY	0	01/74	(9)
	TIME DIGITIZER(4X16BIT,CLOCK RATE 70/85MHZ, WITH CENTER FINDING LOGIC)	TD 2031	SEN	1	/72	
	TIME DIGITIZER (4X16BIT,CLOCK RATE 70/85MHZ,NIM LEVELS)	TD 2041	SEN	1	/72	(4)
	SERIAL TIME DIGITIZER (8X8BIT 100MHZ, SER + SEQUENT COUNT MODE,SHIFT-REG GATE)	STD 2050	SEN	1	/72	

162 Analogue Output Modules (DAC)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	8 CHANNEL 8 BIT D/A CONVERTER (CURRENT OR VOLTAGE O/P,SLOW ANALOG METER DRIVER)	5405	BI RA SYSTEMS	1	/73	
	ANALOG OUTPUT (DAC 8BIT RESOLUTION, +10V OUTPUT RANGE, 5MA)	DO 200-1511	DORNIER	1	/73	
	(SAME BUT 12BIT RESOLUTION)	DO 200-1521		1	/73	
	ANALOG OUTPUT (DAC 8BIT RESOLUTION, +10V OUTPUT RANGE, 5MA, 2 OUTPUTS)	DO 200-1512	DORNIER	1	/73	
	(SAME BUT 12BIT RESOLUTION)	DO 200-1522		1	/73	
	ANALOG OUTPUT (DAC 8BIT RESOLUTION, +AND-10V OUTPUT RANGE, 5MA)	DO 200-1513	DORNIER	1	/73	
	(SAME BUT 12BIT RESOLUTION)	DO 200-1523		1	/73	
	ANALOG OUTPUT (DAC 8BIT RESOLUTION, +AND-10V OUTPUT RANGE, 5MA, 2 OUTPUTS)	DO 200-1514	DORNIER	1	/73	
	(SAME BUT 12BIT RESOLUTION)	DO 200-1524		1	/73	
	ANALOG OUTPUT (DAC 8BIT RESOLUTION, +AND-5V OUTPUT RANGE, 5MA)	DO 200-1515	DORNIER	1	/73	
	(SAME BUT 12BIT RESOLUTION)	DO 200-1525		1	/73	
	ANALOG OUTPUTANG (DAC 8BIT RESOLUTION, +AND-5V OUTPUT RANGE, 5MA, 2 OUTPUTS)	DO 200-1516	DORNIER	1	/73	
	(SAME BUT 12BIT RESOLUTION)	DO 200-1526		1	/73	
	ANALOG OUTPUT (DAC 8BIT RESOLUTION, +10V OUTPUT RANGE, 5MA, 4 OUTPUTS)	DO 200-1517	DORNIER	1	/73	
	(SAME BUT 12BIT RESOLUTION)	DO 200-1527		1	/73	
	ANALOG OUTPUT (DAC 8BIT RESOLUTION, +AND-10V OUTPUT RANGE, 5MA, 4 OUTPUTS)	DO 200-1518	DORNIER	1	/73	
	(SAME BUT 12BIT RESOLUTION)	DO 200-1528		1	/73	
	ANALOG OUTPUT (DAC 8BIT RESOLUTION, +AND-5V OUTPUT RANGE, 5MA, 4 OUTPUTS)	DO 200-1519	DORNIER	1	/73	
	(SAME BUT 12BIT RESOLUTION)	DO 200-1529		1	/73	
C	OCTAL DAC (10BIT,0-5V,50OHMS,10USECS)	DAC 1082	GEC-ELLIOTT	1	/73	
N	(SAME BUT WITH 2'S COMPLEMENT 9BIT+SIGN, +AND- 5V, 50OHMS)	DAC 1082(B)		1	/73	
N	QUAD DAC (4 CHANNEL VERSION OF DAC 1082)	DAC 1042	GEC-ELLIOTT	1	/74	
N	(SAME, 4 CHANNEL VERSION OF DAC 1082(B)	DAC 1042(B)		1	/74	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	DUAL D/A CONVERTER (10 BIT, 10USEC CONV TIME, +10V, +AND-10V, +AND-5V RANGES)	D/A-10	JOERGER	1	/73	
	DUAL D/A CONVERTER (12 BIT, 30USEC CONV TIME, +10V, +AND-10V, +AND-5V RANGES)	D/A-12	JOERGER	1	/73	
N	OCTAL D/A CONVERTER (8BIT RESOLUTION, 0 TO 2MA OR 0 TO +10V OUT)	8 D/A	JOERGER	1	/73	
	D/A CONVERTER (12BIT,5 USEC CONVERSION, O/P RANGES +AND-2.5V/5V/10V AND +5V/10V)	31	JORWAY	1	/71	(2)
	8 CHANNEL 10 BIT D-A CONVERTER	3110	KINETIC SYSTEMS	1	/72	
	DIGITAL TO ANALOGUE CONVERTER	7015	NUCL. ENTERPRISES	1	/70	
	DUAL DIGITAL-TO-ANALOG CONVERTER (10BIT, OUTPUT 0 TO +10V OR -5 TO +5V)	2DAC 2011	SEN	1	/71	
C	DUAL DAC (10BIT, +AND-10V OR +AND-20MA)	C 76451-A15-A2	SIEMENS	1	/73	
C	DUAL DAC (12BIT, +AND-10V)	C 76451-A15-A3		1	/73	(6)

164 Analogue Handling and Processing Modules I (MX)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	SEE ALSO DORNIER ADC TYPES		DORNIER			
	FET MULTIPLEXER (8 DIFF I/P, MAX +OR-10V, DATAWAY SET+INCR ADDRESS)	DO 200-1033	DORNIER	1	/72	
	(WITH FRONT PANEL CONNECTOR)	DO 200-1233		1	/72	
	12 INPUT ANALOGUE MULTIPLEXER (RANDOM OR SCAN ACCESS CONTROLLED BY SKIP REGISTER)	MX 2025	SEN	1	/72	(6)
	15 CHANNEL MULTIPLEXER (ANALOGUE SIGNALS ROUTED TO ADC/DVM,DIRECT + SCAN MODES)	1701	BORER	1	/72	(3)
	RELAY MULTIPLEXER (16 CHANNELS,MAX 200V/750MA OR 10VA, DATAWAY SET+INCR ADDRESS)	DO 200-1035	DORNIER	2	/71	
	(WITH FRONT PANEL CONNECTOR)	DO 200-1235		2	/71	
	RELAY MULTIPLEXER(16 CHANNELS, MAX 200V/750MA OR 10VA, DATAWAY SET+INCR ADDRESS)	DO 200-1036	DORNIER	1	/72	
	(WITH FRONT PANEL CONNECTOR)	DO 200-1236		1	/72	
	ANALOG MULTIPLEXER (15 CHANNELS,REED RELAYS,MAN AND DATAWAY SEL, EXPANDABLE)	AM	JOERGER	2	/72	(6)
	15 CHANNEL RELAY MULTIPLEX	3530	KINETIC SYSTEMS	2	/73	
	MASTER MULTIPLEXER (16 CH, 4 POLE REED)	601	NUCL. ENTERPRISES		/70	
	SLAVE MULTIPLEXER (16 CH, 4 POLE REED)	600			/70	
	16 CHANNEL RELAY MULTIPLEXER STANDARD LEVEL)	J MX 10	SAIP/SCHLUMBERGER	1	/73	
	(SAME FOR LOW LEVEL)	J MX 20		1	/73	
	MULTIPLEXER MANUAL CONTROL	J AX 10		1	/73	
C	16-CHANNEL FAST MULTIPLEXER (FET SWITCHES FOR ADC 1243 AND 1244)	1704	BORER	1	/72	(4)
	FET MULTIPLEXER (16 CHANNELS, MAX +OR-10V,DATAWAY SET+INCR ADDRESS)	DO 200-1031	DORNIER	1	/72	
	(WITH FRONT PANEL CONNECTOR)	DO 200-1231		1	/72	
	FET MULTIPLEXER (16 DIFF I/P, MAX +OR-10V, DATAWAY SET+INCR ADDRESS)	DO 200-1034	DORNIER	1	/72	
	(WITH FRONT PANEL CONNECTOR)	DO 200-1234		1	/72	
	MULTIPLEXER-SOLID STATE (16 SINGLE-ENDED OR 8 DIFF CHAN,RANDOM OR SEQUENT ACCESS)	9026	NUCL. ENTERPRISES	1	/71	
N	32 CHANNEL ANALOG MULTIPLEXER (SERVE AS CHANNEL EXPANDER FOR 5301 DATA SYSTEM)	5101	BI RA SYSTEMS	1	02/74	
	MULTIPLEXER (32 CHANNEL, 2 CONTACTS)	C 76451-A4-A1	SIEMENS	2	/73	
	MULTIPLEXER (32 CHANNEL, 4 CONTACTS)	C 76451-A4-A2	SIEMENS	2	/73	
	FET MULTIPLEXER (32 CHANNELS, MAX +OR-10V, DATAWAY SET+INCR ADDRESS)	DO 200-1032	DORNIER	1	/72	
	(WITH FRONT PANEL CONNECTOR)	DO 200-1232		1	/72	
	FET MULTIPLEXER (32 DIFF I/P, MAX +OR-10V, DATAWAY SET+INCR ADDRESS)	DO 200-1037	DORNIER	2	/72	
	(SAME WITH FRONT PANEL CONNECTORS)	DO 200-1237		2	/72	
	FET MULTIPLEXER (64 CHANNELS MAX +OR-10V, DATAWAY SET+INCR ADDRESS)	DO 200-1061	DORNIER	2	/73	
	(WITH FRONT PANEL CONNECTOR)	DO 200-1261		2	/73	

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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	SAMPLE-AND-HOLD AMPLIFIER (DUAL DIFF AMPL,+/-10V RANGE,20MA OUT,5USEC SETTL)	DO 200-1040	DORNIER	2	/72	
	(SINGLE AMPL VERSION, BOTH TYPES HAVE HOLD AND TRACK MODES)	DO 200-1041		2	/72	
	PROGRAMABLE AMPLIFIER/ATTENUATOR (ATTENUATION -60DB TO 0DB, 6 STEPS, AMPLIFICATION 0DB TO 60DB, 6 STEPS)	DO 200-1052	DORNIER	2	/73	
	PROGRAMABLE AMPLIFIER/ATTENUATOR (ATTENUATION -60DB TO 0DB IN 6 STEPS, GAIN 0DB TO 60DB IN 6 STEPS, 2 CHANNELS)	DO 200-1053	DORNIER	1 NA	/73	
	DIFFERENTIAL AMPLIFIER (GAIN CONTROLLED FROM DATAWAY)	CS 0014	NUCL. ENTERPRISES	2	/72	
	ATTENUATOR (0 DB TO 60 DB, MANUAL AND DATAWAY CONTROLLED)	J AT 10	SAIP/SCHLUMBERGER	3	/70	
	VOLTAGE CALIBRATOR	J ET 10	SAIP/SCHLUMBERGER	1	/73	
	DIGITAL WINDOW DISCRIMINATOR (WITH 128X16BIT BUFFER, PARALLEL + SERIAL I/P)	DWD 2046	SEN	1	/72	(8)

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

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

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

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

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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	EXECUTIVE SUITE ASSEMBLY OF MODULAR CONTROLLERS IN CAMAC CRATE, COVERS SYSTEM COMPLEXITY FROM SINGLE SOURCE-SINGLE CRATE TO MULTI SOURCE-MULTI CRATE SYSTEMS,COMPRISING		GEC-ELLIOTT			
	EXECUTIVE CONTROLLER (TRANSFORMS STANDARD CRATE INTO SYSTEM CRATE)	MX-CTR-2		2	/72	
	BRANCH COUPLER (ONE PER BRANCH, MAX 7)	BR-CPR-2		2	/72	
	AND SYSTEM INTERFACE SOURCE UNITS, ALSO OPTIONALLY AUTONOMOUS CONTROLLER SOURCE UNITS (ALL INSERTED INTO SYSTEM CRATE)		GEC-ELLIOTT			
	AUTONOMOUS CONTROLLER 1 (FOR MULTILEVEL AUTONOMOUS BLOCK TRANSFERS VIA DMA)	SC-ACU-1	GEC-ELLIOTT	1	/73	
	PDP-11 SYSTEM INTERFACE, COMPRISING		GEC-ELLIOTT			
	PROGRAM TRANSFER INTERFACE	PTI-11 C/D		3	/72	
	UNIBUS TERMINATION UNIT	TRM-11		1	/72	
	SYSTEM INTERFACE BUS (LINKS UNIBUS TO ALL SI SOURCE UNITS FORMING INTERFACE)	SI-BUS-X11			/72	
	INTERRUPT VECTOR GENERATOR (ADDS AUTONOMOUS ENTRY OF GL-DERIVED INTERRUPTS)	IVG-11		1	/72	
	DIRECT MEMORY ACCESS INTERFACE (ADDS MULTICHANNEL DMA,NEEDS AUTONOMOUS CTRL)	DMA-11		1	/73	
	NOVA/SUPERNOVA SYSTEM INTERFACE, COMPR		GEC-ELLIOTT			
	PROGRAM TRANSFER INTERFACE	PTI-N C/D		3	/72	
	I/O BUS TERMINATION UNIT	TRM-N		1	/72	
	SYSTEM INTERFACE BUS	SI-BUS-XN			/72	
	INTERRUPT VECTOR GENERATOR	IVG-N		1	/73	
	INTERDATA 70-SERIES SYSTEM INTERFACE COMPRISING		GEC-ELLIOTT			
	PROGRAM TRANSFER INTERFACE	PTI-70 C/D		3	/73	
	I/O BUS TERMINATION UNIT	TRM-70		1		
	SYSTEM INTERFACE BUS	SI-BUS-X70			/73	
	INTERRUPT VECTOR GENERATOR	IVG-70		1	/73	
	HONEYWELL 316/516 SYSTEM INTERFACE,COMPR		GEC-ELLIOTT			
	PROGRAM TRANSFER INTERFACE	PTI-H16 C/D		3	/73	
	I/O BUS TERMINATION UNIT	TRM-H16		1		
	SYSTEM INTERFACE BUS	SI-BUS-XH16			/73	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	GEC 2050/4080 SYSTEM INTERFACE, COMPR		GEC-ELLIOTT			
	DIRECT TRANSFERS INTERFACE	PTI-2050 C/D		3	/73	
	SYSTEM INTERFACE BUS	SI-BUS-X2050			/73	
	SYSTEM CRATE TEST UNIT (TWO-COMMAND TEST UNIT FOR CHECKING SYSTEM CRATE SYSTEMS)	SC-TST-1	GEC-ELLIOTT	3	/72	
	MICROPROGRAMMED BRANCH DRIVER FOR PDP-11 (WITH 256, 512, OR 1K WORDS OF MEMORY)	1201	BI RA SYSTEMS	NA	/72	(5)
	PDP-11 CAMAC CONTROLLER(SEQUENTIAL READ/ WRITE,24 GRADED-L INTERRUPT DIRECTLY)	CA 11-A	D E C	NA	/71	(2)
	PDP-15 CAMAC INTERFACE(18/24BIT,PROGR, SEQUENT ADDR AND BLOCK TRANSFER MODES)	CA 15 A	D E C	NA	/71	(1)
	PDP-9 CAMAC INTERFACE (SOMEWHAT MODIFIED CA 15 A)	CA 15 A/PDP-9	D E C	NA	/71	
	PDP-11 INTERFACE/BRANCH DRIVER (24 VECTOR ADDRESSES, PROGRAMMED AND MULTIPLE DMA-TRANSFER, ADDRESS SCAN AND -LIST MODE, REPEAT-, LAM- AND STOP MODE)	CA 11-C	D E C	NA	/72	(4)
	PDP-11 BRANCH DRIVER (EUR 4600 COMPATI- BLE,PROGRAMMED AND SEQUENT ADDR MODES)	BD-011	EG&G	NA	/71	
	PDP-11 BRANCH DRIVER	KS 0011	KINETIC SYSTEMS	NA	/71	(4)
	INTERFACE AND DRIVER FOR PDP 11 OR PDP 8 MULTI-CRATE SYSTEM, COMPRISING		NUCL. ENTERPRISES			
	BRANCH INTERFACE	9031		2	/72	(7)
	16-BIT CONTROLLER (WITH EITHER OF THE FOLLOWING INTERFACE CARDS)	9030		3	/72	(7)
	PDP 11 INTERFACE CARD	9032			/72	
	INTERFACE CARD FOR DEC PDP 8 SERIES	9034			/73	(7)
	INTERFACE CAMAC-PDP 11 (PROGRAMMED,BLOCK TRANSFER AND SEQUENTIAL ADDR MODES)	ICP 11/ICP 11 A	SAIP/SCHLUMBERGER	NA	/71	(4)
	NOVA BRANCH DRIVER	1251	BI RA SYSTEMS	NA	/73	(5)
	INTERFACE/SYSTEM CONTROLLER TO HP2100, 2114, 2115, 2116	2201	BORER	NA	/71	(4)
	INTERFACE FOR VARIAN 620I/L/F COMPUTER (PROGR,SEQUENT AND BLOCK TRANSFERS)	2204	BORER	NA	/72	
	SYSTEM CONTROLLER FOR SIEMENS 404/3 (TRANSFER OF 16 OR 24 BIT DATAWORDS PARALLEL BRANCH COMMAND CHAINING)	DO 200-2921	DORNIER	6	/73	
	(SAME BUT WITHOUT COMMAND CHAINING)	DO 200-2922		6	/73	
	SYSTEM CONTROLLER FOR SIEMENS 404/3 (TRANSFER OF 16 OR 24 BIT DATAWORDS PARALLEL BRANCH BUT NO COMMAND CHAINING)	DO 200-2923	DORNIER	6	/73	
N	BRANCH DRIVER-INTERFACE FOR SPC-16-SER WITH PROGRAMMED & DMA DATA TRANSFER MODE	CBD 16/MOD 72-077	GENERAL AUTOMATION	0		
	MICRODATA 800/CIP 2000 BRANCH DRIVER	91	JORWAY	NA	/73	(7)
	BRANCH DRIVER (24BIT, PROGR, SEQUENT AND BLOCK TRANSFER MODES, MAX 7 CRATES)	5400	LABEN	4		(8)
	H316/DDP516 CAMAC BRANCH HIGHWAY DRIVER (MEETS EUR 4600 SPECS)		MICRO CONSULTANTS	NA		
	INTERFACE-DRIVER FOR VARIAN 73/620I/620L MULTI-CRATE SYSTEM, COMPRISING		NUCL. ENTERPRISES			(8)
	BRANCH INTERFACE	9031		2	/72	(7)
	16-BIT CONTROLLER AND	9030		3	/72	(7)
	INTERFACE CARD FOR VARIAN 73/620I/620L SERIES COMPUTERS	CS 0044				(8)
C	INTERFACE FOR K202 COMPUTER (24BIT,AUTO- NOMOUS BLOCK TRANSFERS TO/FROM MEMORY, L-NUMBER INTERRUPT ENCODER)	100	POLON	3	/73	
	INTERFACE CAMAC - T2000 A BASIC BRANCH CONTROL RACK	C COB 10	SAIP/SCHLUMBERGER	NA	/73	
C	CAMAC - T2000 BRANCH INTERFACE	T IC 20		NA	/73	
N	SYSTEM CONTROLLER FOR SIEMENS 320/330 (AUTO-GL, 24 VECTOR ADDR, PROGRAMMED & DMA TRANSF, ADDR-SCAN,INCREM,RANDOM LIST REPEAT,LAM & STOP MODES)	C 72451 A1602	SIEMENS	8	/74	

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

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

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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	SINGLE CRATE CONTROLLER TO HP (CERN TYPE 066)	1531	BORER	2	/72	
	SINGLE CRATE SYSTEM CONTROLLERS(SEE EXECUTIVE SUITE, CLASS .211)		GEC-ELLIOTT			
	PDP-11-SERIES CRATE CONTROLLER	1304	BI RA SYSTEMS	2	/73	
	CRATE CONTROLLER/PDP11 UNIBUS INTERFACE	1533A	BORER	2	/72	(4)
	NPR CONTROLLER FOR DMA TO PDP11 E.G. VIA 1533A CRATE CONTROLLER/INTERFACE	1542		NA	/73	(8)
N	SINGLE CRATE CONTROLLER/PDP-11 INTERFACE	CA-11-E	D E C	2	01/74	(9)
	DEDICATED CRATE CONTROLLER FOR PDP-11 (MULTIPLE TRANSFER OR AUTO ADDRESS SCAN)	DC011	EG&G	2		(7)
	UNIBUS CRATE CONTROLLER PDP-11	3911	KINETIC SYSTEMS	2	/72	
	INTERFACE AND DRIVER FOR PDP 11 OR PDP 8 SINGLE CRATE SYSTEM, COMPRISING		NUCL. ENTERPRISES			
	16-BIT CONTROLLER (WITH EITHER OF THE FOLLOWING INTERFACE CARDS)	9030		3	/72	(7)
	PDP 11 INTERFACE CARD	9032			/72	
	INTERFACE CARD FOR DEC PDP 8 SERIES	9034			/73	(7)
	AUTONOMOUS CONTROLLER FOR PDP 11	9033	NUCL. ENTERPRISES	2	/73	(8)
	CAMAC CRATE-PDP 11 INTERFACE	J CC 11	SAIP/SCHLUMBERGER	2		(7)
	CRATE INTERFACE FOR PDP 8/I	J CPDP 8/I	SAIP/SCHLUMBERGER	3	/73	
C	CRATE-SYSTEM CONTROLLER FOR PDP-11 (24 BIT READ & WRITE CAPABILITIES)	C-CSC-11	WENZEL ELEKTRONIK	2	/72	
	NOVA-SERIES CRATE CONTROLLER	1303	BI RA SYSTEMS	2	/73	
	SINGLE CRATE CONTROLLER TO HP DATA+RANGE IN,12BIT REG O/P FOR CONTROL)	1531	BORER	1	/72	(3)
	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	
	CONTROLEUR DE CHASSIS MULTI 20 - CAMAC (24BIT,PROGR,SIMULT I/O,INTERRUPT MODES)	JCM 20	INTERTECHNIQUE	3	/73	
	INTERFACE-DRIVER FOR VARIAN 73/620I/620L SINGLE CRATE SYSTEM,COMPRISING		NUCL. ENTERPRISES			(8)
	16-BIT CONTROLLER AND	9030		3	/72	(7)
	INTERFACE CARD FOR VARIAN 73/620I/620L SERIES COMPUTERS	CS 0044				(8)
N	CRATE INTERFACE FOR MULTI 20	J CM 20	SAIP/SCHLUMBERGER	1	/74	
C	CRATE CONTROLLER 320	C 72451-A1446-A6	SIEMENS	3	/72	
C	CRATE CONTROLLER 404	C 76451-A1446-A7	SIEMENS	2	/73	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR

214 Controllers for Autonomously Operated Systems (and Related Units)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	DATA PROCESSOR (AUTONOMOUS PROGRAMABLE SINGLE DATAWAY CONTROLLER 16 REGISTERS	DO 200-2951	DORNIER	3	/73	
	(SAME WITH 32 REGISTERS)	DO 200-2952		3	/73	
	(SAME WITH 48 REGISTERS)	DO 200-2953		3	/73	
	(SAME WITH 64 REGISTERS)	DO 200-2954		3	/73	
	PROGRAM MEMORY (READ-ONLY MEMORY, 256 WORDS OF 16 BITS)	DO 200-2961	DORNIER	1	/73	
	(SAME BUT 512 WORDS OF 16 BITS)	DO 200-2962		1	/73	
	(SAME BUT 768 WORDS OF 16 BITS)	DO 200-2963		1	/73	
	(SAME BUT 1024 WORDS OF 16 BITS)	DO 200-2964		1	/73	
	ADDITIONAL MEMORY (RANDOM ACCESS MEMORY 1024 WORDS 16 BIT)	DO 200-2971	DORNIER	1	/73	
	(SAME BUT 2048 WORDS OF 16 BITS)	DO 200-2972		1	/73	
	(SAME BUT 3072 WORDS OF 16 BITS)	DO 200-2973		1	/73	
N	PROGRAM MEMORY FOR PROCESSOR (2K PROM)	DO 200-2965	DORNIER	2	03/74	
N	(SAME BUT 3K PROM)	DO 200-2966		2	03/74	
N	(SAME BUT 4K PROM)	DO 200-2967		2	03/74	

217 Other Parallel Mode Interfaces/Drivers/Controllers

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	SYSTEM 3000 CONTROLLER (FOR DISTRIBUTED INTERFACE SYSTEM, PARALLEL MODE)	1552	BORER	2	/72	
N	SYSTEM CRATE CONTROLLER	3960	KINETIC SYSTEMS	2	/73	
N	MODCOMP I,MODCOMP II & MODCOMP III SYSTEM DRIVER(USE WITH 3960)	3970		2	/73	
N	PDP-11 SYSTEM DRIVER (USE WITH 3960)	3971		2	04/74	
N	MANUAL SYSTEM DRIVER(USE WITH 3960)	3980		2	/73	

22 Interfaces/Controllers/Drivers for Serial Highway

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	SYSTEM 3000 CONTROLLER (FOR DISTRIBUTED INTERFACE SYSTEM, SERIAL MODE)	1551	BORER	2	/72	(9)
	SERIAL EXTENSION UNIT, 8 BIT BYTE SERIAL LINK, BRANCH COMPATIBLE, CONSISTING OF		JOERGER		/73	(8)
	SERIAL DRIVER (TERMINATES BRANCH HIGHWAY AND RETRANSMITS COMMAND SERIALLY)	SD		2		
	SERIAL RECEIVER (RECEIVES SERIAL DATA, DRIVES TYPE A-1 SYSTEM, OPTICAL ISOL)	SR		2		
N	TYPE L-1 CRATE CONTROLLER FOR THE "STANDARD" SERIAL HIGHWAY	3950	KINETIC SYSTEMS	2	03/74	(9)

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

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

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

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

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	TYPE A-1 (ESONE) CRATE CONTROLLER	CC-A1	STND ENGINEERING	2	/72	(6)
	TYPE A1 CONTROLLER WITH TERMINATOR (MEETS 4600 SPECS OF JAN 1972)	CCT-A1	STND ENGINEERING	2		
	CRATE CONTROLLER TYPE D (CONFORMS TO EUR 4100, USED WITH DO 280 COMPUTER SYSTEM)	DO 200-2901	DORNIER	2	/71	

232 Lam Graders

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	LAM GRADER (24 BIT MASK REGISTER, PLUG-IN PATCH BOARD, CERN 064)	LG 2401	GEC-ELLIOTT	1	/72	
	LAM GRADER (INTERNALLY PATCHABLE, SWITCH SELECTABLE MULTI-CRATE BG-RESPONSE)	LG	JOERGER	1	/73	(8)
	LAM GRADER-SORTER	75	JORWAY	3	/73	(7)
	LAM GRADER (DESIGNED TO EUR 4600 SPECS)	064	NUCL. ENTERPRISES	1	/72	(4)
	LAM GRADER (CERN SPECS 064)	C 107	RDT	1	/71	
	LAM GRADER (CERN SPECS 064)	LG 2001	SEN	1	/72	(6)

233 Terminations (Simple, with Indicators)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	BRANCH HIGHWAY TERMINATOR	6601	BI RA SYSTEMS	1	/73	
	BRANCH HIGHWAY TERMINATOR	6602	BI RA SYSTEMS	1	/73	
	CC-11 TERMINATOR	6603	BI RA SYSTEMS	2	/73	
C	TERMINATION UNIT	1592	BORER	1	/73	
	TERMINATOR MODULE (BRANCH HIGHWAY TERMINATOR)	TC024	EG&G	2	/71	
	BRANCH HIGHWAY TERMINATION MODULE(MOUNTS DIRECTLY ON BRANCH HIGHWAY ASSEMBLY)	CD 18107	EMIHUS	NA	/72	
	BRANCH TERMINATION UNIT (NON INDICATING)	BT 6503	GEC-ELLIOTT	2	/72	
	BRANCH TERMINATION UNIT	BT 6601	GEC-ELLIOTT	2	/71	
	BRANCH TERMINATOR	BT	JOERGER	2	/72	
	BRANCH TERMINATION WITH INTEGRAL CABLE	50C	JORWAY	2	/72	
	BRANCH TERMINATOR IN A CONNECTOR	BT-01	KINETIC SYSTEMS	NA	/73	
	BRANCH TERMINATOR	J BT 20	SAIP/SCHLUMBERGER	2	/71	
	CRATE CONTROLLER BUS TERMINATOR FOR A-1 CRATE CONTROLLER	BT 2042	SEN	1	/72	
	BRANCH HIGHWAY TERMINATOR	BHT-001	STND ENGINEERING	1	/73	
	BRANCH HIGHWAY TERMINATOR, WITH DISPLAY	BHT-002/D	STND ENGINEERING	2	/73	
C	BRANCH TERMINATOR (FULL BRANCH MONITOR WITH INTERNAL STORAGE AND LED DISPLAY)	BT 6502	GEC-ELLIOTT	2	/72	
	VISUAL BRANCH TERMINATOR (STORES AND DISPLAYS ON LEDS BRANCH SIGNALS)	VBT	JOERGER	2	/72	(6)
	BRANCH TERMINATION WITH BRANCH DISPLAY	51	JORWAY	2	/72	
C	BRANCH TERMINATION UNIT (WITH INDICATOR AND POWER SUPPLY)	C 72451-A10-A1	SIEMENS	NA	/73	(3)

234 Branch Extenders, Bus Extenders

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	EXTENDED BRANCH SERIAL DRIVER	3990	KINETIC SYSTEMS	3	03/74	
	DIFFERENTIAL BRANCH EXTENDER (FOR EXTENDING BRANCHES UP TO 3 KM)	DBE 6501	GEC-ELLIOTT	2	/71	
	DIFFERENTIAL MODE BRANCH HIGHWAY EXTENDER (BI-DIRECTIONAL)	55	JORWAY	NA	/73	(7)
	BRANCH HIGHWAY TRANSCEIVER FOR LONG DISTANCE TRANSMISSION	J BHT 10	SAIP/SCHLUMBERGER	2		(4)
	UNIBUS EXTENDER, TRANSMITTER RECEIVER (FOR DISTANCES UP TO 200 METRE OR MORE)	1594 1595	BORER	2 2	/72 /72	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR

3 TEST EQUIPMENT

31 System Related test Gear

SYSTEM TEST UNIT (FOR EXECUTIVE SUIT SYSTEM CONFIGURATION, SEE MX-CTR-2)	SC-TST-1	GEC-ELLIOTT	3	/72	

311 Computer Simulators

PDP-11 SIMULATOR	6101	BI RA SYSTEMS	NA	/72	(5)

32 Branch Related Testers/Controllers and Displays

321 Branch Testers/Controllers (Manual, Programmed)

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

33 Dataway Related Testers and Displays

331 Dataway Controllers/Testers Manual, Programmed)

MANUAL CRATE CONTROLLER	GFK-LEM	EISENMANN	8	/71	
MANUAL CRATE CONTROLLER	MCC	JOERGER	5	/72	
MANUAL DATAWAY CONTROLLER	7024-1	NUCL. ENTERPRISES	8	/70	
MANUAL CRATE CONTROLLER	J CMC 10	SAIP/SCHLUMBERGER	8	/71	(1)
MANUAL DATAWAY CONTROLLER/DISPLAY SYSTEM		SAIP/SCHLUMBERGER		/71	
INTERFACE TO DATAWAY	D AI 10 J DA 10		1		
CONTROL AND DISPLAY CRATE	C AI 10		NA		
TEST MODULE FOR CRATE CONTROLLER AND DATAWAY	DTM 2040	SEN	1	/72	
MANUAL 24 BIT CRATE CONTROLLER	MCC-240	STND ENGINEERING	2	/72	(5)
ADDRESS SCANNER (MANUAL CONTROL OF CRATE OPERATIONS)	C-AS-20	WENZEL ELEKTRONIK	2	/72	
DYNAMIC TEST CONTROLLER (GENERATES ALL POSSIBLE CAMAC COMMANDS IN SINGLE CRATE)	TC 2403	GEC-ELLIOTT	3	/71	
DYNAMIC TEST CONTROLLER (2 SIMULT TRANSF SINGLE,STEP-BY-STEP AND CONTINUOUS MODE)	C 108	RDT	8	/71	(4)

332 Dataway Displays

CAMAC TEST MODULE/DATAWAY DISPLAY	6102	BI RA SYSTEMS	2	/73	
CAMAC DATAWAY DISPLAY (DATAWAY SIGNAL PATTERN STORED/DISPLAYED,2 TEST MODES)	1801	BORER	1	/71	(1)
CAMAC DATAWAY TEST AND DISPLAY MODULE	LEM-52/16,2	EISENMANN	1		
DATAWAY TEST MODULE(FULL DATAWAY MONITOR WITH INTERNAL STORAGE AND LED DISPLAY)	DTM 3	GEC-ELLIOTT	1	/72	
DATAWAY MEMORY (DISPLAY + READABLE REGISTER)	C 340	INFORMATEK	1	/72	
DATAWAY DISPLAY (STORES AND DISPLAYS DATAWAY SIGNALS, FARWQXCIZS1S2BP1P2)	DD	JOERGER	1	/72	(6)
DATAWAY DISPLAY	3290	KINETIC SYSTEMS	1	/72	
DATAWAY DISPLAY	C 76451-A16-A1	SIEMENS	1	/73	(6)
DATAWAY DISPLAY MODULE	DD-002	STND ENGINEERING	1	/72	(5)
DATAWAY DISPLAY	C-D1-24	WENZEL ELEKTRONIK	1	/72	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR

34 Module Related Test Gear (Module Extenders)

341 Module Extenders

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
C	CAMAC EXTENDER MODULE	8201	BI RA SYSTEMS	1	/73	
	EXTENSION FRAME (MODULE EXTENDER)	FF 1-1	GEC-ELLIOTT	1	/71	
	MODULE EXTENDER (+AND-6V,+AND-24V FUSED, RETRACTABLE LOCKING DEVICE)	ME	JOERGER	1	/72	
	EXTENDER MODULE	11	JORWAY	1	/71	
	EXTENDER CARD	1100	KINETIC SYSTEMS	1	/71	(4)
	EXTENSION UNIT	7007-1	NUCL. ENTERPRISES	1	/70	
C	EXTENDER MODULE	061	POLON	1	/73	
	EXTENDER	CEX	RDT	1	/72	
	MODULE EXTENDER	ME 2030	SEN	1	/70	
	EXTENDER (XXX=LENGTH OF CABLE IN MM BEYOND RACK, SINGLE WIDTH)	577/XXX	TEKDATA	1	/72	(5)
	EXTENDER (XXX=LENGTH OF CABLE IN MM BEYOND RACK, DOUBLE WIDTH)	5813/XXX		2	/73	

37 Other Test Gear for CAMAC Equipment

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

4 CRATES, SUPPLIES, COMPONENTS, ACCESSORIES

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

411 Crates with Dataway and Supply

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	CRATE (270VA,COOLED,MODULAR POWERED BY UP TO 8 REGULATORS 1922 OR 1925+1922)	1902A	BORER	25	/69	
	VOLTAGE REGULATOR (FOR +OR-24V/6A, +/-12V/7A,+/-6V/8A/16A24A)	1922			/69	
	VOLTAGE REGULATOR (+AND-6V, 25A MAX, 270W RATING, USABLE WITH 4X1922)	1925			/73	
N	CAMAC MINICRATE		EDS SYSTEMTECHNIK	17	/73	
C	POWERED CRATE	MC200	EG&G	25	01/74	
	CONVERTS FASTON CONNECTORS TO RECOMMEND-ED FIXED POWER CONNECTOR ON CHOSEN CRATE	/AMP	GEC-ELLIOTT		/73	
N	POWERED CRATE (+&-6V/40A, +&-24V/8A, 200V/.1A, 117V AC, MAX 300W)	CPU/11	GRENSON		/73	
N	POWERED CRATE (SAME, WITHOUT MONITORING)	CPU/12			/73	
	POWERED CRATE	1500	KINETIC SYSTEMS	NA	/73	
	POWER CRATE (7005-2 CRATE WITH 9022 POWER SUPPLY)	9023	NUCL. ENTERPRISES	24	/71	(2)
	POWERED CRATE (+AND-6V/25A, +AND-24V/6A, (INCL POWER DESIGN TYPE AEC432 SUPPLY)	NSI-875CC100AEC432	NUCL. SPECIALTIES	25	/72	
C	POWERED CRATE (6U,VENTILATED,NO FAN,130W +6V/15A,-6V/4A,+AND-24V/2A,+200V/50MA)		POLON	25	/71	
	CAMAC POWER SUPPLY (+AND- 6V/25A, +AND- 24V/6A)	AEC-432	POWER DESIGNS	25	/72	
	POWERED CRATE	CCHN-CSAN	RDT	25	/71	
	POWERED VENTILATED CRATE (+6V/24A, -6V/16A, +AND-24V/3A, MAX 400W)	C JAL-41	SAIP/SCHLUMBERGER	25	/73	(8)
	POWERED CRATE(SEE P4 ALJ 13)	C4 ALJ 13 D	SAPHYMO-SRAT	25	/71	(1)
	POWERED CRATE(SEE P6 ALJ 13)	C6 ALJ 13 D		25		(1)
	POWERED CRATE(SEE P7 ALJ 13)	C7 ALJ 13 DW		25		(1)
	POWER SUPPLY (CAMAC CRATE)	CM5125/53/DW/BIP	SAPHYMO-SRAT	25	/72	
	POWER SUPPLY (CAMAC CRATE)	CM5125/53/AW/BIP		25		
	POWER CRATE (200W MAX,+6V/25A,-6V/10A, +AND-12V/3A,+AND-24V/3A,200V/0.05A)	PC 2006/B	SEN	25	/70	
	POWER CRATE (200W MAX,+6V/25A,-6V/10A, +AND-24V/3A,200V/0.05A)	PC 2006/C		25	/71	
	POWERED CRATE (7U,VENT,+AND-6V/26A,+AND-12V/6.5A,+AND-24V/6.5A,200V/0.1A,200W)	C 76455-A2	SIEMENS	25	/71	(3)
	POWERED CRATE (SAME BUT WITH 117V AC)	C 76455-A1		25	/71	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	POWERED CRATE (+AND-6V/25A, +AND-24V/6A, OPTIONAL +AND-12V/3A,+AND-200V/0.1A)	PCS	STND ENGINEERING	25		(5)

412 Crates with Dataway, without Supply

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	VENTILATED CRATE (STANDARD 24 STATION FASTON CONNECTORS)	VC 0010	GEC-ELLIOTT	24	/70	
	VENTILATED CRATE (STANDARD 25 STATION FASTON CONNECTORS)	VC 0011	GEC-ELLIOTT	25	/72	
	VENTILATED CRATE (HEAVY DUTY 25 STATION FASTON CONNECTORS)	VC 0021		25	/72	
	CAMAC CRATE VERDRAHTET (EMPTY CRATE WITH WIRED DATAWAY)	2,084,000,6	KNUERR	25	06/74	(2)
	CRATE	7005-2	NUCL. ENTERPRISES	24	/70	
	CAMAC COMPATIBLE CRATE (WIRED)	NSI-875 DB-WV	NUCL. SPECIALTIES	25	/71	
	CAMAC CRATE (WIRED)	NSI-875 CC 100	NUCL. SPECIALTIES	25	/72	
C	UNPOWERED CRATE WITH DATAWAY (6U, EMPTU, VENTILATED, NO FAN)	012	POLON	25	/71	
	UNPOWERED CRATE WITH DATAWAY ( )	CM 5125/33/AW	SAPHYMO-SRAT	25	/71	
	(360 MM)	CM 5125/33/DW		25		
	( )	CM 5125/53/AW		25		
	(525 MM)	CM 5125/53/DW		25		
	UNPOWERED CRATE WITH DATAWAY AND CONNECTORS	UPC 2029	SEN	25	/70	
	CRATE (WIRED CRATE)	WCS	STND ENGINEERING	25		(5)
C	CRATE (WITH DATAWAY AND VENTILATION)	C 76455-A3	SIEMENS	25	/72	

417 Blank Crates and Other Components and Accessories

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	CRATE (5U,EMPTY, 25 STATIONS)	MCF/5CAM/S/25	IMHOF-BEDCO	25	/71	
	(SAME BUT WITH 24 STATIONS)	MCF/5CAM/S/24		24	/72	
	CRATE (6U,EMPTY,WITH VENTILATION BAFFLE, 25 STATIONS, HARWELL TYPE 7000)	MCF/6CAM/SV/25		25	/71	
	(SAME BUT WITH 24 STATIONS)	MCF/6CAM/SV/24		24	/72	
	CRATE (6U,EMPTY,WITH VENTILATION BAFFLE, REMOVABLE PANEL, 25 STNS, HARWELL 7000)	MCF/6CAM/SVR/25		25	/71	
	(SAME BUT WITH 24 STATIONS)	MCF/6CAM/SVR/24		24	/72	
	CRATE (6U EMPTY,WITH VENTILATION BAFFLE)	IB/9905-5HV1	OSL/IMHOF-BEDCO	25	/73	
	FAN MOUNTING PLATE (FOR IB/9905-5HV1)	CAM/FM			/73	
	CAMAC CRATE (EMPTY)	2,080,000,6	KNUERR	25	/70	(2)
	CAMAC CRATE (EMPTY,INCL HARDWARE SUPPLY CHASSIS AND VENTILATION PANEL)	2,086,000,6		25		(2)
	CAMAC COMPATIBLE CRATE	NSI 875 DB/WV	NUCL. SPECIALTIES	25	/70	
	CAMAC CRATE (UNWIRED)	NSI 875 CC 100	NUCL. SPECIALTIES	25	/72	(5)
	CHASSIS CAMAC (6 UNITES AVEC FENTE DE VENTILATION, 525 MM PROFONDEUR)	9905-1-05	OSL	25	/71	
	(360 MM PROFONDEUR)	9905-2-05		25	/71	
C	CRATE (6U, EMPTY, VENTILATED, NO FAN)	010	POLON	25	/71	
	VENTILATED CRATE NO POWER NO DATAWAY (TWO FANS)	CCHN	RDT	25	/71	
	(SAME WITH 3 FANS)	CCHNA		25	/72	
	CAMAC CRATE (EMPTY CRATE)	C	STND ENGINEERING	25		
	CAMAC CRATE (EMPTY CRATE)	CS		25		
	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 CRATE (EMPTY) HEAVY DUTY		OSL/WILLSHER&QUICK		/73	
	6U WITH VENTILATION BAFFLE	9905-5HV		25	/73	
	5U NON VENTILATED	9905-5H		25	/73	
	DEPTH OPTIONS 360MM, 460MM, 525MM					
N	CAMAC CRATE WITH VENTILATION BAFFLE (6U, 525MM DEPTH)	99055HV3AVD/98/525	OSL/WILLSHER&QUICK	25	/73	
N	(SAME BUT WITH 460 MM DEPTH)	99055HV3AVD/98/460		25	/73	
N	(SAME BUT WITH 360 MM DEPTH)	99055HV3AVD/98/360		25	/73	
	1U COOLING DRAWER (FOR CRATE ONLY, 2 FANS, FITS 6U CRATE)	CDR 1	GEC-ELLIOTT		/72	
	2U COOLING DRAWER (COOLS CRATE AND CRATE MOUNTED PS 0003,FAN+CONTROL PANEL INCL)	CDR 2	GEC-ELLIOTT		/72	
	VENTILATION UNIT	CAM/FV	IMHOF-BEDCO		/73	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	LUFTEREINHEIT (VENTILATION UNIT,COMPLETE WITH 3 FANS AND FILTER)	2.081.000.6	KNUERR		/70	
	(VENTILATION UNIT,NO FAN,NO FILTER)	2.085.000.6				
N	AIR SCOOP (STOPS CHIMNEY EFFECT BETWEEN UN-VENTILATED CRATES IN RACK, 1U HIGH)	NSI-12109-AS	NUCL. SPECIALTIES	NA	/71	
	FAN UNIT (FOR ALB/10 SUPPLY SYSTEM)	VALB/10	SAPHYMO-SRAT		/72	
	CRATE BLOWER UNIT		STND ENGINEERING			(5)
	VENTILATION UNIT	1UVCAM	WILLSHER & QUICK		/71	(3)
	1U VENTILATION GRILL	1 UG	OSL/WILLSHER+QUICK		/72	

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

421 Multi-Crate Supplies

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	POWER SUPPLY FLEXIBLE SYSTEM COMPRISING	CPU/1	GRENSON		/71	
	BASIC CRATE(FOR SUPPLY MODULES,INCLUDES REFERENCE,CONTROL AND 200V/0,1A)	CFC				
	SUPPLY MODULE (+6V/6A)	CFP/6				
	(-6V/6A)	CFM/6				
	(+12V/3A)	CFP/12				
	(-12V/3A)	CFM/12				
	(+24V/3A)	CFP/24				
	(-24V/3A)	CFM/24)				
	POWER SUPPLY SYSTEM (CRATE) (MODULE OPTIONS AS FOLLOWS)	C4 BIP 203	SAPHYMO-SRAT		/72	
	POWER SUPPLY MODULE 6 V 10 A	BIP B6 10				
	6 V 15 A	BIP C6 15				
	6 V 20 A	BIP D6 20				
	6 V 40	BIP E6 40				
	12 V 7 A	BIP B12 7				
	12 V 10 A	BIP C12 10				
	12 V 15 A	BIP D12 15				
	12 V 25 A	BIP E12 25				
	24 V 3,5A	BIP B24 35				
	24 V 6 A	BIP C24 6				
	24 V 9 A	BIP D24 9				
	24 V 15 A	BIP E24 15				
	SUPPLY CHASSIS 2KW (RAW SUPPLY FOR REGULATOR MODULES)	ALB/10	SAPHYMO-SRAT		/73	(2)
	FAN UNIT	VALB/10				
	WIRED RACK 42 U	BC 42				
	POWER SUPPLY MODULE 6 V 5 A(REGULATOR)	BPR 605				
	6 V 10 A	BPR 610				
	6 V 25 A	BPR 625				
	12 V 2 A	BPR 122				
	12 V 5 A	BPR 125				
	24 V 3 A	BPR 243				
	24 V 5 A	BPR 245				

422 Single-Crate Supplies

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	COMPACT POWER SUPPLY UNIT (CRATE/PANEL MOUNT,+AND-6V/25A,+AND-24V/6A,200/300W)	PS 0003	GEC-ELLIOTT		/71	
	CAMAC POWER UNIT (+6V/15A,-6V/3A,+24V/2A -24V/2A,200V/0,05A,117VAC)	CPU/4	GRENSON			
	CAMAC POWER SUPPLY (+6V/20A,-6V/5A,+AND-24V/5A,200V/0,05A)	CPU/2	GRENSON		/71	
	POWER SUPPLY (+6V/20A,-6V/5A, +AND-12V/2A,+AND-24V/3A)	CPU/5	GRENSON		/71	
	POWER SUPPLY (RACK MOUNTING,+6V/25A, -6V/15A,+AND-24V/5A,200V/0,1A)	CPU/6	GRENSON		/71	
	POWER SUPPLY (RACK MOUNTING,+6V/25A, -6V/15A,+AND-24V/5A,+AND-12V)	CPU/7	GRENSON		/71	
	POWER SUPPLY (+6V/20A,-6V/5A, +AND-24V/5A,200V/0,05A)	9001	NUCL. ENTERPRISES		/71	
	POWER UNIT (+6V/15A,-6V/3A, +AND-24V/2A,200V/0,05A)	9022	NUCL. ENTERPRISES		/71	(2)
C	POWER SUPPLY (RACK MOUNTING,+6V/15A, -6V/4A,+AND-24V/2A,+200V/50MA,130W)	CZC-10	POLON		/73	
	POWER UNIT (+6V/20A, -6V/15A,+24V/2A, -24V/2A,200V/0,1A)	SP 426	POWER ELECTRONICS		/74	
	POWER SUPPLY (+6V/25A,-6V/5A, +AND-12V/2A,+AND-24V/3A,200V/0,1A)	C 303	RDT		/71	

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	POWER SUPPLY UNIT (+6V/10A,-6V/2A,+AND-24V/1.5A)	P4 ALJ 13	SAPHYMO-SRAT		/71	
	(+6V/5A,-6V/1.5A,+AND-12V/1.5A, +AND-24V/1.5A)	P6 ALJ 13				
	(+6V/25A,-6V/10A,+AND-12V/3A, +AND-24V/3A,+200V/0.1A,MAX 200W)	P7 ALJ 13				
	SUPPLY (+AND-6V/26A,+AND-12V/6.5A,+AND-24V/6.5A,200V/0.1A,117V AC, 200W MAX)	C 76455-A4	SIEMENS		/72	
	SUPPLY (SAME BUT WITHOUT 117V AC)	C 76455-A5			/72	
	POWER SUPPLY AND BLOWER UNIT	1410 S	STND ENGINEERING			(5)
	POWER SUPPLY (+AND-6V/6A SHARED AND +AND-24V/2A SHARED, METERING OF V AND I)	825	STND ENGINEERING			

427 Blank Supply Chassis, Other Components/Accessories

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	POWER SUPPLY CRATE (STANDARD)	MCF/4/PPC	IMHOF-BEDCO	NA	/71	
	POWER SUPPLY CRATE (WIRED)	MCF/PPC/WV		NA	/71	
	NETZTEILCHASSIS (EMPTY SUPPLY CHASSIS)	2.082.000.6	KNUERR		/70	
	POWER SUPPLY CRATE(FOR SEPARATE SUPPLY)	CSAN	RDT		/71	
	VOLTAGE MONITOR PANEL USING LEDS	MP 2	GEC-ELLIOTT	1	/72	
	MAINS SWITCH ASSEMBLY	MS 3	GEC-ELLIOTT	NA	/71	
	POWER SUPPLY MONITOR PANEL (WITH MAINS SWITCH, TEST POINTS AND LED INDICATION)	PSMP 1	GEC-ELLIOTT	NA	/72	
	POWER INDICATOR	0704	NUCL. ENTERPRISES	NA	/70	

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

431 Branch Related (Cables, Connectors etc.)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	BRANCH HIGHWAY CABLE	8102	BI RA SYSTEMS		/73	
	BRANCH HIGHWAY CABLE	BH001	EG&G		/71	
	BRANCH HIGHWAY CABLE	CD 18067-27	EMIHUS		/70	
	(COMPLETE PTFE CABLE ASSEMBLY,27CM LONG)					
	(1 METER LONG)	CD 18067/107			/71	
	(2 METERS LONG)	CD 18067/207			/71	
	BRANCH HIGHWAY CABLE ASSEMBLY (WITH CONNECTORS,27 CM LONG)	CC 66 POL PB-27	EMIHUS		/71	
	(XX CM LONG,PVC JACKET)	CC 66 POL PB-XX				
	BRANCH HIGHWAY CABLE (WITH CONNECTORS, 27 CM LONG)	BHC 027	GEC-ELLIOTT		/72	
	SAME,***=067,107 & 207 FOR CORRESP LENGTH IN CM,OTHER LENGHTS TO SPEC ORDER	BHC ***			/72	
	BRANCH HIGHWAY CABLE		JOERGER			
	BRANCH CABLE WITH CONNECTOR (1.5 FT TO 75 FT LONG)		JORWAY		/71	
	BRANCH HIGHWAY CABLE (66 TWISTED PAIRS)	CL 90	SAIP/SCHLUMBERGER		/71	
	BRANCH HIGHWAY CABLE ASSEMBLY (COMPLETE WITH CONNECTORS, LENGTH 27 CM)	BHC 27	SEMRA-BENNEY		/72	
	(SAME, XXX=LENGTH IN CM, 040,100 ETC)	BHC XXX			/72	
	BRANCH HIGHWAY CABLES(COMPLETE WITH CONNECTOR,XXX = LENGTH IN METERS)	2000/S/132/XXX	TEKDATA		/71	(4)
	BRANCH HIGHWAY CONNECTOR (FIXED MEMBER,SOCKET MOULDING)	WSS0132S00BN000	EMIHUS		/70	
	(FREE MEMBER,PIN MOULDING, PXX YYY SELECTS JACKSCREW)	WSS0132PXXBNYYY				
	HOOD (FOR FREE MEMBER)	WAC 0132 H005				
	BRANCH HIGHWAY CABLE ONLY (PLAIN PVC JACKET)	66 POL PB	EMIHUS		/71	
	EXTENDED BRANCH CABLE (LOW COST TELE-PHONE CABLE FOR LONG BRANCH RUNS)	EBC XXXX	GEC-ELLIOTT		/72	
	BRANCH HIGHWAY CABLE (132-WAY)	LIY-Y72X2X0,088	LEONISCHE		/72	
N	BRANCH HIGHWAY CABLE (TRUE 132-WAY WITH METALISED POLYESTER SCREEN, PVC JACKET)	LI2Y(ST)Y66X2X0.18	LEONISCHE			
	CABLE FOR BRANCH HIGHWAY (PVC JACKET)	132 PE 189	PRECICABLE BOUR		/71	
	(BRAIDED RILSAN JACKET)	132 PE 210				
	(MEPLAT 20MMX10.8MM,GAINE PVC NOIR)	132 PE 291			/72	
	CABLE EXTENSION MODULE (JOINS TWO BRANCH HIGHWAY CABLES)	CD 18106	EMIHUS		/72	
	BRANCH HIGHWAY TO PDP-11 (COMPLETE WITH CONNECTORS, XXX= LENGTH IN METERS)	5805/P/132/XXX	TEKDATA		/73	(8)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR

432 Dataway Related (Connectors, Boards, Assemblies)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	DATAWAY MOTHERBOARD (MULTILAYER PNB)	DM-1	STND ENGINEERING			
	DATAWAY SOCKET (MOTHERBOARD COMPLETE WITH 25 CONNECTORS)	CIM	RDT		/70	
	DATAWAY MINI WRAPPING (MOTHERBOARD WITH 25 DATAWAY CONNECTORS)	J/DW	SAPHYMO-SRAT		/71	
	CAMAC MULTILAYER (DATAWAY MOTHERBOARD)	CM-8-69	TECH AND TEL		/71	
	DATAWAY CONNECTOR, EDGE TYPE II	163633	AMP AG		/70	
	DATAWAY CONNECTOR,FLOWSOLDER TERMINATION (ADD MOUNTING BRACKETS R500014900000000)	R500014800000000	CARR FASTENER		/70	
	MINI WRAP TERMINATION	R500016800000000			/70	
	SOLDER SLOT TERMINATION				/70	
	DATAWAY CONNECTOR (MINIWRAP)	EAA 043 D301	EMIHUS		/71	(2)
	CONNECTEUR,FUTS DROITS (DATAWAY CONNECTOR,STRAIGHT PINS)	KF86 254 BED T	FRB CONNECTRON		/70	
	FUTS WRAPPING (WIRE WRAP PINS)	KF86 254 BEY T				
	FUTS A SOUDER (SOLDER PINS)	KF86 254 BES T				
C	CAMAC DATAWAY CONNECTOR (* INSERT A FOR SOLDER TAG, B SOLDER PIN, C MINI WRAP)	G03D 086P 28 * BL	ITT CANNON		/73	(6)
C	CAMAC-LEISTE(DATAWAY CONNECTOR,WIREWRAP)	4,000,060,0	KNUERR		/70	
	DATAWAY FEMALE CONNECTOR, MINI-WRAP	2422 061 64334	PHILIPS		/71	(5)
	*=1 FOR WIRE SOLDER, 5 FOR BOARD SOLDER	2422 061 643*4				(5)
	DATAWAY MALE CONNECTOR (MATING THE CRATE MOUNTED 86-WAY CONNECTOR SOCKET)	2422 060 14314	PHILIPS		/72	(5)
	CONNECTEUR 254 DOUBLE FACE (DATAWAY CONNECTOR,WIRE WRAP)	254 DF 43 AWV	SOCAPEX		/70	
	(MOTHERBOARD SOLDER)	254 DF 43 AYV			/70	
	(WIRE SOLDER)	254 DF 43 AZV			/70	
	DATAWAY CONNECTOR (MINI-WRAP)	8606 86 21 15 000	SOURIAU		/71	
	(WIRE-SOLDER)	8606 86 21 10 000				
	(FLOW SOLDER)	8606 86 21 14 000				
	DATAWAY CONNECTOR (*=2 FLOW SOLDER,*=3 SOLDER LUGS,*=4 MINIWRAP,AU PLATING)	C 288* CSP 221	UECL		/71	
	(FLOW SOLDER,NI + AU PLATING)	C 2885 CSP 221				
	(13 MINIWRAP CONTACTS,OTHER ARE FLOW SOLDER,NI + AU PLATING)	C 2886 CSP 221				
	(*=7 MINIWRAP,*=8 SOLDER LUGS, NI + AU PLATING)	C 288* CSP 221				
	MOUNTING BRACKETS FOR ABOVE	C 8523				

433 Module Related (Blank Modules, Patchboards etc.)

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
N	CAMAC CARRYING CASE (8 & 12 MODULES)		HENESA		/73	
	BLANK MODULE KIT (SINGLE WIDTH) NEW SIMPLIFIED DESIGN	BM 1	GEC-ELLIOTT	1	/73	
	(SAME,*=2,3 & 4 FOR CORRESP WIDTH)	BM *				
	SINGLE CARD MOUNTING KIT (EMPTY MODULE)	BCK/5CAM/CM1	IMHOF-BEDCO	1	/71	
	(SAME, *=2,3 & 4 FOR CORRESP WIDTH)	BCK/5CAM/CM*				
	DOUBLE ENCLOSED BIN KIT (EMPTY MODULE)	BCK/5CAM/BM2	IMHOF-BEDCO	2	/71	
	(SAME, *=3 & 4 FOR CORRESP WIDTH)	BCK/5CAM/BM*			/71	
	SINGLE CARD MOUNTING KIT (EMPTY MODULE,SHORT SCREEN PLATE)	CAM/M1/A	IMHOF-BEDCO	1	/72	
	(SAME,*=2,3 & 4 FOR CORRESP WIDTH)	CAM/M*/A			/73	
	SINGLE CARD MOUNTING KIT (EMPTY MODULE, (EMPTY MODULE,LONGT SCREEN PLATE)	CAM/M1/B		1	/72	
	(SAME,*=2,3 & 4 FOR CORRESP WIDTH)	CAM/M*/B			/73	
	CAMAC HARDWARE	CH-001	KINETIC SYSTEMS	1	/71	(4)
	CAMAC-KASSETTE (EMPTY MODULE,WIDTH 1/25)	2,090,001,8	KNUERR	1	/70	(2)
	(*=2,3,4,5,6 FOR CORRESPONDING WIDTHS)	2,090,00*,8			/70	
	CAMAC COMPATIBLE MODULE (EMPTY, WIDTH=1, ALSO IN 2 & 3 UNIT WIDTHS)	NSI 875 DM	NUCL. SPECIALTIES	1	/70	
C	CAMAC MODULE (EMPTY MODULE HARDWARE)	NSI 875 CM-100-1	NUCL. SPECIALTIES	1	/72	(5)
C	(SAME, *= 2, 3, & 4 FOR CORRESP WIDTH)	NSI 875 CM-100-*			/72	(5)
	CAMAC MODULE,SHIELDED (EMPTY, 1 WIDTH)	NSI-875-DM/SPH-1	NUCL. SPECIALTIES	1	/71	
	(SAME, *=2, 3, AND 4 FOR CORRESP WIDTH)	NSI-875-DM/SPH-*			/71	
C	CAMAC MODULE (EMPTY,W=1/25)	021	POLON	1	/71	
C	(*=2,3,4,6 & 8 FOR CORRESP WIDTH)	02*			/71	
C	(*=0&2 FOR WIDTH 10 & 12 RESPECTIVELY)	03*			/71	
	EMPTY MODULE 1 UNIT	CCA 1	RDT	1	/70	
	(SAME,*=2,3 & 4 FOR CORRESP WIDTH)	CCA *				

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	EMPTY MODULE SCREENED (1 WIDE, ADD TYPE SUFFIX A FOR SHORT, B FOR LONG SCREENS)	CM1	SEMRA-BENNEY	1	/73	
	(DITO, *=2,3,4 OR 6 FOR CORRESP WIDTH)	CM*				
	MODULE HARDWARE (EMPTY MODULE, W=1/25, ALSO AVAILABLE W=2/25,3/25 & UP TO 8/25)		STND ENGINEERING	1		
	CAMAC MODULE (EMPTY,1/25 CARD MODULE)	CAMCAS 1	WILLSHER & QUICK	1	/71	(2)
	(*=2,3 & 4 FOR CORRESPONDING WIDTH)	CAMCAS *				(2)
	CAMAC MODULE (EMPTY,1/25 CARD MODULE)	CAMCAS 1-G	WILLSHER & QUICK	1	/72	
	(*=2,3 & 4 FOR CORRESPONDING WIDTH)	CAMCAS *-G			/72	
	CAMAC MODULE(EMPTY,1/25 SCREENED MODULE)	CAMMOD 1-G	WILLSHER & QUICK	1	/72	
	(*=2,3 & 4 FOR CORRESPONDING WIDTH)	CAMMOD *-G			/72	
	CAMAC MODULE(EMPTY,2/25 SCREENED MODULE)	CAMMOD 2	WILLSHER & QUICK	2	/71	(2)
	(*=3 & 4 FOR CORRESPONDING WIDTH)	CAMMOD *				(2)
	EMTY MODULE WITH HINGED CARDS (2/25)	9905-CB2	OSL/WILLSHER&QUICK	2	/73	
	(3/25)	9905-CB3		3	/73	
	EMPTY MODULE (1/25)	9905-5T1	OSL/WILLSHER&QUICK	1	/73	
	(**= T2, T3, T4, T5, T6, T8, T10, AND T12 FOR CORRESPONDING WIDTH)	9905-5**			/73	
	TIROIR MODULAIRE POUR COMMANDE	9905-TC-1	OSL	1	/71	
	BLANK CAMAC MODULE PC BOARD (GOLD PLATED & ETCHED FINGERS BOTH SIDES)	NSI-04071-PC	NUCL. SPECIALTIES		/71	
	MK-1 KLUGE MODULE (131 MIXED 14, 16, 24 PIN SOCKETS)	8301	BI RA SYSTEMS	2	/73	
	MK-5 KLUGE MODULE (HAS 70 14 PIN, 13 AND 2 24 PIN WIRE WRAP SOCKETS)	8305		2	/73	
N	MK-6 KLUGE MODULE (HAS 34 14 PIN, 16 16 PIN & 3 24 PIN WIRE WRAP SOCKETS)	8306		1	/73	
	CAMAC-UNIVERSAL-BOARD(PRINTED CARD MODULE WITH 28 14-PIN + 28 16-PIN SOCKETS)	DO 200-2900	DORNIER	2	/71	
	CAMAC PROTOTYPE ASSEMBLY BOARDS (MX B1 HAS 68 SITES, MX B2 HAS 80 SITES)	MX B1/MX B2	GEC-ELLIOTT	NA	/71	
	(MX B3 HAS 68 SITES,MX B4 HAS 80 SITES, MX B3/MX B4 INCLUDE 5V CIRCUIT)	MX B3/MX B4		NA	/71	
	GENERAL PURPOSE IC PATCHBOARD (MAX 33 14/16-PIN AND 5 24-PIN DIP,WIRE WRAP)	CAMAC CG 164	GSPK	NA	/70	(2)
	PRINTED CIRCUIT TEST BOARD	10	JORWAY	NA	/71	
	KLUGE CARD (FOR CREATING YOUR OWN CAMAC MODULES)	2000-36	KINETIC SYSTEMS	1	/71	(4)
	KLUGE CARD	2000		1	/73	
C	EXPERIMENTIERPLATTE (PRINTED CIRCUIT BOARD)	4,000,087,0	KNUERR	NA	/70	
N	EXPERIMENTIERPLATTE (P.C.B.)	4,000,088,0		NA	/73	
N	DECODED MATRIX BOARD (FOR PROTOTYPE WIRING OF 64 14-PIN SITES, A&F DECODED)	D 21 621	NUCL. ENTERPRISES	0	06/74	
	MODULE PRINTED CIRCUIT BOARDS(TAKE 24,16 OR 14 PIN, ON THE WHOLE 1092 PINS)	CBP 1	RDT	NA	/72	
	(SAME, WITH MINI-WRAP TO 0V AND +6V)	CBP 2		NA	/72	
	BLANK MODULE(COMPLETE WITH PRINTED BOARD FOR 69 INTEGRATED CIRCUITS,1 U WIDTH)	BM 2020/1U	SEN	1	/70	
	(SAME,2U WIDTH)	BM 2020/2U		2	/70	
	EXPERIMENT PLATE	C 72468-A453-A1	SIEMENS	1	/72	

437 Other Recommended or Standard Components/Access.

NC	DESIGNATION + SHORT DATA	TYPE	MANUFACTURER	WIDTH	DELIV.	NPR
	NIM ADAPTOR	7009-2	NUCL. ENTERPRISES	NA	/70	
	NIM-CAMAC ADAPTOR	CAN	RDT	NA	/71	
	NIM/CAMAC ADAPTOR	ANC 10	SAIP/SCHLUMBERGER		/72	
	CAMAC NIM ADAPTOR	CNA 2033	SEN	2	/71	
	LAM GRADER CABLE (20CM, WITH CONNECTORS)	LGC 20	GEC-ELLIOTT		/72	
	(40CM, WITH CONNECTORS)	LGC 40			/72	
	LAM GRADER CABLE		JOERGER			
	52 WAY CANNON 2DB52S HARNESSES LAM GRADER CABLE, XXX= LENGTH IN METERS)	5809/S/52/XXX	TEKDATA		/73	
	52-WAY DOUBLE DENSITY CONNECTOR (FIXED MEMBER WITH PINS,LAM GRADER CONNECTOR)	2 DB 52 P	ITT CANNON		/70	
C	COAXIAL CONNECTOR (PANEL MOUNTING, CABLE CONNECTOR HAS TYPE F 00.250 & FS 00.250)	RA 00.250	LEMO		/70	(4)

INDEX OF MANUFACTURERS

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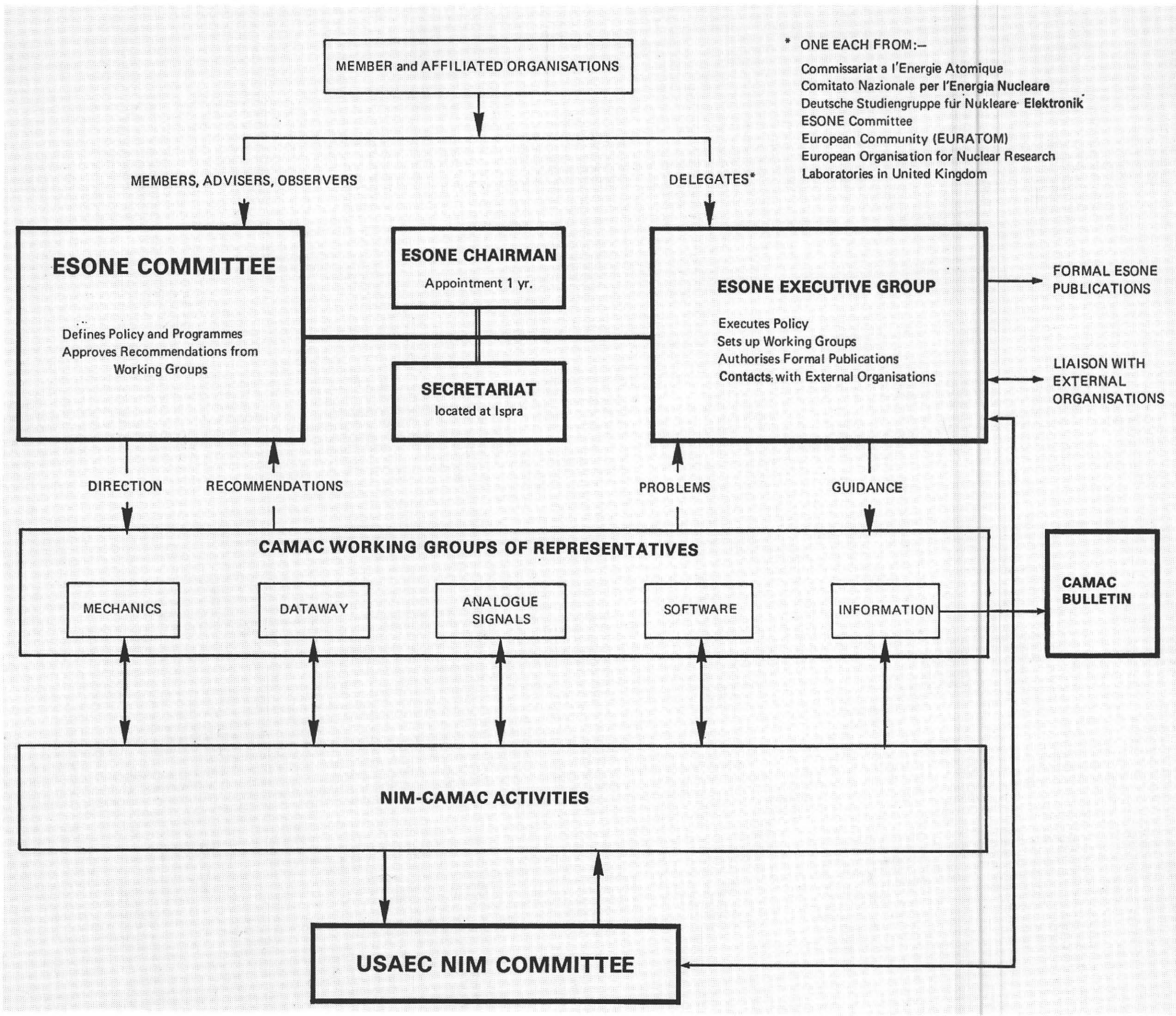

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