# CAMAC
# *bulletin*



A publication
of the
ESONE Committee



ISSUE No. 3
March 1972

## PRINCIPAL CONTENTS OF PREVIOUS CAMAC BULLETIN ISSUES



## CONTRIBUTIONS TO FUTURE ISSUES

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

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

## On the cover:

View of landscape at CEN Saclay. This is the largest Nuclear Research Centre of the Commissariat à l'Énergie Atomique (CEA) situated near Paris. The third ESONE general Assembly was held here in 1963. (The statue represents URANIE, Muse of Astronomy and Geometry.)

# CAMAC

*bulletin*

**Editorial Working Group :**

H. Meyer, Chairman
W. Attwenger
R.C.M. Barnes
W. Becker
H. Bisby
P. Gallice
O.Ph. Nicolaysen

**Production Editor:**

C E C — DG XIII

**Correspondence to:**

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

**Distributed by:**

Commission des
Communautés Européennes
29, rue Aldringen
Luxembourg




## CONTENTS OF THIS ISSUE



## PAPERS RECEIVED FOR FUTURE ISSUES

Methods of Demand Handling by H.J. Trebst, Physics Institute, University Erlangen, Germany

Application of a Multicrate CAMAC System to a pion electroproduction experiment (PEP) by D. Clarke, M.W. Collins, A.G. Wardle - Daresbury Nuclear Physics Laboratory, England.

Lieber Leser,

Vor einigen Monaten hat für das ESONE Komitee das zweite Jahrzehnt seiner Tätigkeit begonnen. Nachdem zunächst die ersten internationalen Spezifikationen für transistorisierte Geräte in Kassettenbauweise erarbeitet worden waren (EUR 1831), befasste sich das ESONE Komitee in den letzten fünf Jahren im wesentlichen mit der grundsätzlichen Definition und Auslegung der CAMAC Spezifikationen (EUR 4100, EUR 4600, EUR 5100).

Mit grosser Freude kann ich Ihnen heute mitteilen, dass die Arbeitsgruppen „Dataway" und „Mechanics" ihre Arbeit an der revidierten Fassung des Dokuments EUR 4100 e, beendet haben. Das ESONE Komitee wird in Kürze diese neue Fassung mit der Bezeichnung EUR 4100 e (1972) veröffentlichen. Ausserdem kann jetzt damit gerechnet werden, dass die Arbeitsgruppe „Software" ihren Vorschlag für eine CAMAC Sprache in überarbeiteter und ergänzter Form auf der nächsten ESONE Jahrestagung vorlegen wird.

Allen, die auf beiden Seiten des Atlantiks mit viel Mühe zum Gelingen dieser Arbeiten beigetragen haben, sei herzlich gedankt.

In der Zukunft wird sich das ESONE Komitee bemühen, die CAMAC Spezificationen weiterzuverbreiten und zu verbessern, gestützt auf die schon gewonnenen und noch zu sammelnden Erfahrungen. Dabei wird der Ausdehnung des Anwendungsbereiches von CAMAC besondere Aufmerksamkeit geschenkt werden, um die Verwendungsmöglichkeiten umfassender zu nutzen. Ich hoffe sehr, dass das CAMAC Bulletin auch in dieser Hinsicht eine wertvolle Hilfe für Entwickler und Benutzer in Forschung und Industrie sein wird.

K. D. MÜLLER
*Vorsitzender des ESONE Komitees 1971/72*

*Dear Reader,*

*Some months ago, the ESONE Committee entered a second decade of its work. Having devised the specification for the first multi-national modular unit system of transistorized nuclear equipment, (EUR 1831), the main activity of the last 5 years has been to define the CAMAC specification (EUR 4100, EUR 4600, EUR 5100).*

*I have great pleasure in stating that the Dataway and Mechanics Working Groups have now completed the revision of EUR 4100 e. The ESONE Committee will publish, in the near future, this revised document as EUR 4100 e (1972). It is very possible also that the Software Working Group will present, at the next ESONE Annual General Assembly, a revised and extended version of the original proposal for a CAMAC language. My very sincere thanks go to all those, on both sides of the Atlantic, who have contributed so much effort to this work.*

*The ESONE Committee, in future, will be anxious to develope and improve CAMAC to satisfy present and new requirements and particularly with a view to its use in those areas that may benefit from its technical innovation. I sincerely hope, also in this context, that the CAMAC Bulletin will be of valuable assistance to designers and users alike in both research and industrial fields.*

K.D. MÜLLER
*Chairman of the ESONE Committee 1971/72*

# HIGHLIGHTS OF THE ESONE GENERAL ASSEMBLY

## SACLAY — OCTOBER 1971

The 1971 Annual General Assembly was held during 5th-7th October, at the Centre d'Études Nucleaires, Saclay, in association with an exhibition of CAMAC equipment and facilities as at CERN Geneva last year.

The occasion was the TENTH anniversary of the formation of the ESONE Committee. It is of some interest to reflect on the past since the significance, for the future, of any one event can be judged only within its historical context.

Founded on the desire by many laboratories to promote the ideal of interlaboratory-compatible electronic equipment, the ESONE Committee has experienced many ups and downs in its pursuit of this ideal. As with most other Committees, the membership has grown over the years however, unlike many Committees, the Saclay meeting demonstrated that the ESONE Committee's enthusiasm and work programme is now just as great as 10 years ago and perhaps more effective. The reasons for this are clear. Every member is personally involved in the decisions taken because he has to live with them when applied in his own laboratory and he hopes they will assist in easing his work load. The effectiveness of the Committee has been strengthened by experience, by the widening expertise from new members and in the recognition of its work on CAMAC by Commercial Companies. All these give justified hope that the work of the Committee will continue to be successful even though the situation in many of its member organisations is entering a more difficult period than has been the case for many years.

At the Saclay meeting, 57 representatives were present from 27 member organisations, 2 associated organisations of the USAEC NIM Committee and 7 other interested organisations, among these one from Canada and one from Brazil. The Committee was pleased to welcome representatives from its new member organisations:

| | |
|---|---|
| Mr. Per Skaarup | Research Establishment, Risö, Roskilde, Denmark. |
| Mr. A.J. Vickers | Culham Laboratory, Abingdon, England. |
| Mr. A. Axmann | Institut Max von Laue,-Paul Langevin, Grenoble, France. |
| Mr. Ph. Briandet | Laboratoire de l'Accélérateur Lineaire, Orsay, France. |
| Mr. J. Biri | Central Research Institute for Physics, Budapest, Hungary. |

Dr. K.D. Müller from Kernforschungsanlage, Jülich, West Germany was elected ESONE Chairman for 1971/72 in succession to Mr. M. Sarquiz of Centre d'Études Nucléaires, Saclay, France.

In his review of the year's work, the retiring Chairman pointed to the dominant activities—the revision of EUR 4100, the final drafting of EUR 4600, the modification of EUR 5100, the study of the CAMAC Software Language, and the distribution of the first Issue of the CAMAC Bulletin all of which had involved a total of 14 meetings in Europe and some in America.

This work was rewarded by the Assembly's approval of the text of EUR 4600 e. This text involved some changes to the earlier specification of the Crate Controller A and to distinguish Controllers, designed to the earlier specification, any new Controllers would be designated as Crate Controllers Type A-1. The text for EUR 5100 e was also approved with a reference to exclude its application to very fast signals, for which topic a new Working Group would be set up.

A notable deviation from earlier Assemblies was the introduction of many joint sessions with Company Representatives. These included the retiring chairman's review and sessions directed to system applications, new developments and discussions of problems with CAMAC.

Significant reports emerging during the Assembly included one from the International Electrotechnical Commission TC.45 meeting held in Bucharest (Sept. '71), to the effect that the I.E.C. were anxious to establish liaison with ESONE. The creation of a comprehensive bibliography on CAMAC was announced by Dr. K. Tradowsky of KFZ Karlsruhe, who also appealed for copies of all new references to CAMAC.

The exhibition was provided by 29 commercial companies from Belgium, France, Germany (Fed. Rep.), U.K., Italy, Poland, Switzerland and the United States of America. It was again most interesting and contained a wide variety of exhibits ranging from CAMAC components (cable assemblies, connectors, motherboards, etc.) to complex controllers. A clear impression was obtained of a vigorous and highly competitive commercial backing for CAMAC.

In closing the Assembly, Dr. Müller expressed his keen desire to have formal publication of the CAMAC Specifications, to encourage applications of CAMAC outside the nuclear field and to continue the close and helpful collaboration with the I.E.C. and the USAEC NIM Committee.

# NEWS

### ANNUAL GENERAL ASSEMBLY 1972

The invitation has been accepted from the Kernforschungsanlage, Jülich (KFA-ZEL) to hold the 1972 ESONE General Assembly at Jülich, West Germany. The programme will start on Tuesday morning, 3rd October, and continue until Thursday, 5th October. A decision will be made later, on the topic of an associated exhibition, after the opinions of CAMAC supply companies have been obtained.

### CAMAC SEMINARS

The two-day CAMAC Seminars, which are regularly featured by the Post Graduate Education Centre, Harwell, will continue in 1972. The dates are 15-16 March and 25-26 October and the course fee, excluding accommodation, is £25 per student. Application forms are available from P.G.E.C., AERE, Harwell, Berkshire, England and early application is recommended.

# ESONE ANNOUNCEMENTS

### Mr. Gallice replaces Mr. Sarquiz in the ESONE Committee

As a consequence of changes within the 'Services d'Electronique du CEN/Saclay', Mr. M. Sarquiz has been replaced by Mr. P. Gallice, as the representative of CEA on the Executive Group of the ESONE Committee, and the CEN member of the ESONE Committee and its Working Groups.

Michel Sarquiz, a past-chairman of the Committee, has been associated with ESONE work from its very beginning, even before the name ESONE was invented, and his personal contribution throughout this time is well-known and recognised by all who have worked with him. The Committee and all his personal friends wish him success and satisfaction in his new work at Saclay.

The Committee also welcomes Pierre Gallice, who is already known to many members, confident that effective collaboration with Saclay and the CEA will continue and flourish under his guidance.

### EUR 4600 and EUR 5100 approved by ESONE General Assembly

During the General Assembly, 5th-7th October, at Saclay, the ESONE Committee approved the amended draft texts of document EUR 4600e, 'CAMAC, Organisation of Multi-Crate Systems, Specification of the Branch Highway and CAMAC Crate Controller Type A-1'.

Furthermore the ESONE Committee approved during the same Assembly the draft text of document EUR 5100e, 'CAMAC, Specification of Amplitude Analogue Signals' with a proviso that a statement will appear to the effect that the specifications do not apply to very fast signals.

### ESONE Chairman 1971-72

Dr. Klaus D. Müller, of Kernforschungsanlage Jülich, Germany, was elected ESONE Chairman for 1971-72 at the Annual General Assembly held at Saclay (5-7 October, 1971). A Chairman is appointed at each A.G.A. to serve for the period following the General Assembly.

---

# NEWS

### USAEC-NIM COMMITTEE ENDORSES CAMAC SPECIFICATION

During the Meeting held on 2nd November, 1971 in San Francisco, California, the AEC Committee on Nuclear Instrument Modules endorsed the Branch Highway Specification EUR 4600 as follows:

> 'The NIM Committee endorses the branch highway and CAMAC crate controller specifications of EURATOM Publication EUR 4600 e (about to be published), while recognising that other systems, including those utilising controllers dedicated to specific computers, are also useful. The NIM Committee intends to co-operate with and maintain contact with the ESONE Committee with regard to those specifications and to provide guidance to U.S. laboratories and manufacturers'.

### ADOPTION OF CAMAC IN INDIA

Mr. V.A. Petha of the Electronics Division, Bhaba Atomic Research Centre, Trombay, India reports that CAMAC has been adopted for data handling purposes in conjunction with NIM at that Centre.

### ONE-LINE CONTROL SYSTEMS CONFERENCE WITH PAPERS ON CAMAC

The Institution of Electrical Engineers (U.K.), in association with the Institute of Mathematics, the Institute of Measurement and Control and the Institution of Electronic and Radio Engineer's, is holding a Conference at the University of Sheffield 18-20 April, 1972—'Trends in On-Line Computer Control Systems'. Papers on CAMAC topics will be presented as follows:

- The Potential of a Standard Highway-Interface (CAMAC) for Computer Systems in Real-Time Applications. By A.C. Peatfield, Daresbury Nuclear Physics Laboratory, U.K.
- Some Recent Implementations of Computer Control in Austria using CAMAC. By W. Attwenger, Research Centre Seibersdorf, Austria.
- Experience in the Use of a Standard Computer Interface for Laboratory Automation by G.B Collins, A.B. Keats, A.E.E., Winfrith, U.K.

Registration forms are available from IEE Conference Dept., Savoy Place, London, W.C. 2R OBL, England.

# (1) AN INTRODUCTION TO CAMAC

## A CAMAC LANGUAGE

by

P. Wilde
HEP Electronics Group
Rutherford High Energy Laboratory
Chilton Berkshire, U.K.

*SUMMARY A CAMAC programming language is being developed by the Software Working Group. This paper is a general introduction to this language. It discusses the advantages of such a language and gives examples of some of the statement types. A method of implementing a translator for the language is suggested.*

The Software Working Group of the ESONE committee is considering the design of CAMAC languages and this paper is an introduction to a language now in an advanced stage of development.

### INTRODUCTION

A CAMAC language is a language containing statements which reflect the characteristics in the specifications EUR 4100 and EUR 4600 which themselves define the functional details of CAMAC. It is a programming language in the sense of a language suitable for expressing sequences of CAMAC operations and may be used for communicating this information not only from man to machine but from man to man. The general adoption of a standard language will have many advantages. Programs will be easier to write and, equally important, easier to read; the transfer of program descriptions will be easier as the peculiarities of the interface between the computer and CAMAC are eliminated; programs may be transferred between compatible installations and, finally, co-operation in the writing of translators will be possible.

The particular features of the language which simplify the understanding of programs are the following.

(a) Descriptive names may be defined and used to refer to functional entities in a CAMAC system. For example a register implementing a counting function at a particular sub-address of a module may be given the name SCALER. Another register even at the same sub-address of the module but accessed through group 2 functions may be given the name STATUS. At a higher level a collection of crates may be given the name EXPERIMENT1 and a branch may be given the name LAB2.

(b) The particular details of I/O format and conventions of specific computers and system controllers (interfaces) are not apparent to the application programmer.

(c) The book-keeping associated with block transfers can be organised and optimised by the system software.

It must be understood that it is only meaningful to apply this language to an installation that has the basic ability to communicate with CAMAC either by assembly language code, by sub-routine calls or by input/output packages in a higher level language. The CAMAC language simply provides a standard format which results in the generation of the basic code.

### CAMAC LANGUAGE STATEMENTS

The most usual form of statement specifies three components, a CAMAC function, a CAMAC address and a computer store identifier. The control functions generally do not need a computer address. Statements may be labelled for referencing. The general form of statement and examples are as follows:

| label-identifier: | camac-function | camac-address | computer-address |
|---|---|---|---|
| GETDATA: | READ | SCALERARRAY | BUFFER |
| | CLEAR | SCALERARRAY | |
| | WRITE | CONTROL | STATUSWORD |
| | F(28) | CONTROL | |

These example statements specify the following operations:

(a) read (F(0)) data from a defined group of scalers and deposit the contents in a buffer in the computer store;

(b) clear (F(9)) the scalers;

(c) load (F(17)) a control module with a statusword specifying the details of the next run;

(d) initiate the next run using a non-standard function (F(28)) which has been used for this purpose in the control module.

Other statements allow the specification of conditional jumps depending on the Q line. For example:

IF LAM CONTROL GOTO GETDATA.

This would cause the sensing of the LAM condition of the control module, probably by a Test LAM (F(8)) function. If the LAM was set then it would result in a program branch to a code segment labelled GETDATA.

Interrupt control can be specified both at module and at higher level. For example:

ENABLE EXPERIMENT.

This could enable the D signals from several crates which are common to a particular experiment and have been allocated the name EXPERIMENT. Also associated with interrupts is a statement which allows the linking of a demand with a named service routine in the program.

Most of the remaining statements are associated with the allocation of names and mnemonics. Names can be allocated to software arrays, usually acting as data buffers. There is need to differentiate between

CAMACLENGTH (24 bit) and COMPUTER-LENGTH data.

An equivalence statement enables the programmer to alter function code mnemonics and choose appropriate punctuation characters.

The most complex naming problem is that associated with the naming of CAMAC hardware.

## CAMAC HARDWARE NAMES

The association of a name and a single CAMAC module sub-address may be specified simply using the three numbers C, N and A with the possible addition of a fourth, B for branch. A typical allocation statement might be

REGISTER = (C, N, A)

where C, N and A are the appropriate numbers specifying the hardware address.

The naming of arrays presents many more problems. Again an obvious specification would be to use starting, finishing and incrementing values for each of C, N of A. Questions immediately arise. What is the starting value of N? Does it refer only to the first crate or to each crate? Similar questions apply to the finishing address. What is the last usable station number in a crate? Is it always 23? When these questions are answered it is found that more than the basic information mentioned above is needed. Such a specification is only manageable if a high degree of uniformity exists. What if a scaler array logically includes different types of scalers with different widths and different numbers of subaddresses. Automatic Q-scan solves this problem in operation, so the language should allow the specification of such arrays. Similarly there is no need for all modules of a hardware array to be contiguous though it would be very unusual for them not to be.

All these possibilities lead to extremely complex expressions and the simplification of these is an outstanding problem. The present idea is to develop the names hierarchically. Intermediate names are given to the larger units, for example branches and crates. These names can then be used to refer to smaller elements such as modules.

## IMPLEMENTATION

The CAMAC language being considered does not include any of the facilities normally associated with data processing, the movement of data within store, the performance of arithmetical and logical operations and the specification of normal peripheral activity. It must therefore be augmented by a conventional programming language (assembly language, Fortran) to provide these facilities. This results in a mixed language program with CAMAC language statements embedded in a host language.

The most obvious translator implementation would be a two-stage system. The first stage taking the CAMAC language statements and producing equivalent host language statements and necessary declarations. The second stage, the host language standard translator would then provide the run-time code. The two stages may be either in a two-pass form or in a more compact form operating in series by statement but in parallel by program.

The language specification makes no assumptions as to the way it may be used. It may be used in a conventional compile and run mode or, with a suitable host language it could be run interpretively.

## STATUS

This paper presents a general view of a CAMAC language. It is intended as a gentle introduction to some of the ideas and terminology of a detailed report which should appear shortly. The syntax does not always agree with the final document but is felt to be more understandable at an introductory level in its present form.

The details and the final report of the described language have been determined by the Software Working Group of the ESONE Committee. The form and presentation of this introduction is the author's own interpretation.

# NEWS

## STANDARD MULTI-PIN CONNECTORS FOR CAMAC AT CERN*

The ESONE Committee—after careful consideration by the Dataway Working Group has standardised the Hughes 132-pin connector for use in Crate Controllers Type A and the Branch Highway defined in document EUR 4600 e (equivalent mating types could also be approved by the Committee).

The CERN Electronics Standardisation Committee, after a serious comparison and also experience with other manufacturers, has decided to confirm this choice and extend the use of this type of connector for all CERN modules, particularly in CAMAC, but also in the CIM system (internal standard of which NIM/CAMAC are subsets).

The decision was taken to introduce the full existing series and even to promote the creation of a 58-pin version. The 108-pin version (as often used in U.K.) will also be introduced. The full series consists of:

| | |
|---|---|
| 14 pins | Original Manufacturer: Hughes Aircraft Company, Type WSS subminiature Connector. Selected pin types are for AWG 28-30, AWG 22-26. |
| 38 pins | |
| 58 pins (new product) | |
| 88 pins | |
| 108 pins | |
| 132 pins (ESONE Standard) | |
| 244 pins | |

It is very important to note that connectors with 14/38/58/88 pins can be mounted easily on a single width CAMAC module, even when side covers are used. Cables for all these connectors will be made available and their types may be announced in another Bulletin.

* A communication from the CERN Electronics Standardisation Committee (Secretary: H. R. Haeubi, FIN Division) and the CERN ESONE delegate (F. Iselin).

# ② CAMAC DATAWAY - BRANCH HIGWAY TIMING RELATIONSHIP VIA THE CRATE CONTROLLER

## DISCUSSION, SPECIFICATIONS AND OPTIONS

by

F. Iselin, B. Löfstedt, and P. Ponting

N. P. Division, CERN, Geneva, Switzerland

*SUMMARY An overall timing diagram is presented containing timing information about the Dataway and the Branch Highway, the correlation of which is done by the Crate Controller (typically A or similar). Some necessary new criteria and definitions are included as well as CERN-NP preferred, but narrower, tolerances for crate controllers. A new 'HOLD' feature is described.*

*The diagram presented should help to remove existing ambiguities. It proposes definitions or test values where appropriate (see details in CERN-NP CAMAC Note 38-00).*

## INTRODUCTION

The Dataway timing is described in EUR 4100 e, Fig. 9 and relevant text, and the Branch Highway timing is described in EUR 4600 e, Tables III, IV, Figs. 3, 4 and text.

When one is faced with the problem of understanding fully the meaning of these timings, particularly Fig. 9 of EUR 4100 e, in order to design or select crate controllers, it soon appears that some additional information or definitions are required. In the course of this study it was decided to also include CERN-NP 'preferred values'—inside the large basic tolerances—with the intention of obtaining a limited total cycle-time and a certain 'quality level' in crate controllers.

## MAJOR POINTS CONSIDERED

### Test Conditions for a Crate Controller

The CC is tested outside the Dataway with 'ideal' loads as defined in Table VI of EUR 4100 e (pull-up voltage 4.1 V, see later). This procedure avoids the simulation of undefined figures for Dataway impedance(s). The values given should be held over a temperature range of 10 to 60°C as measured 'inside the module'.

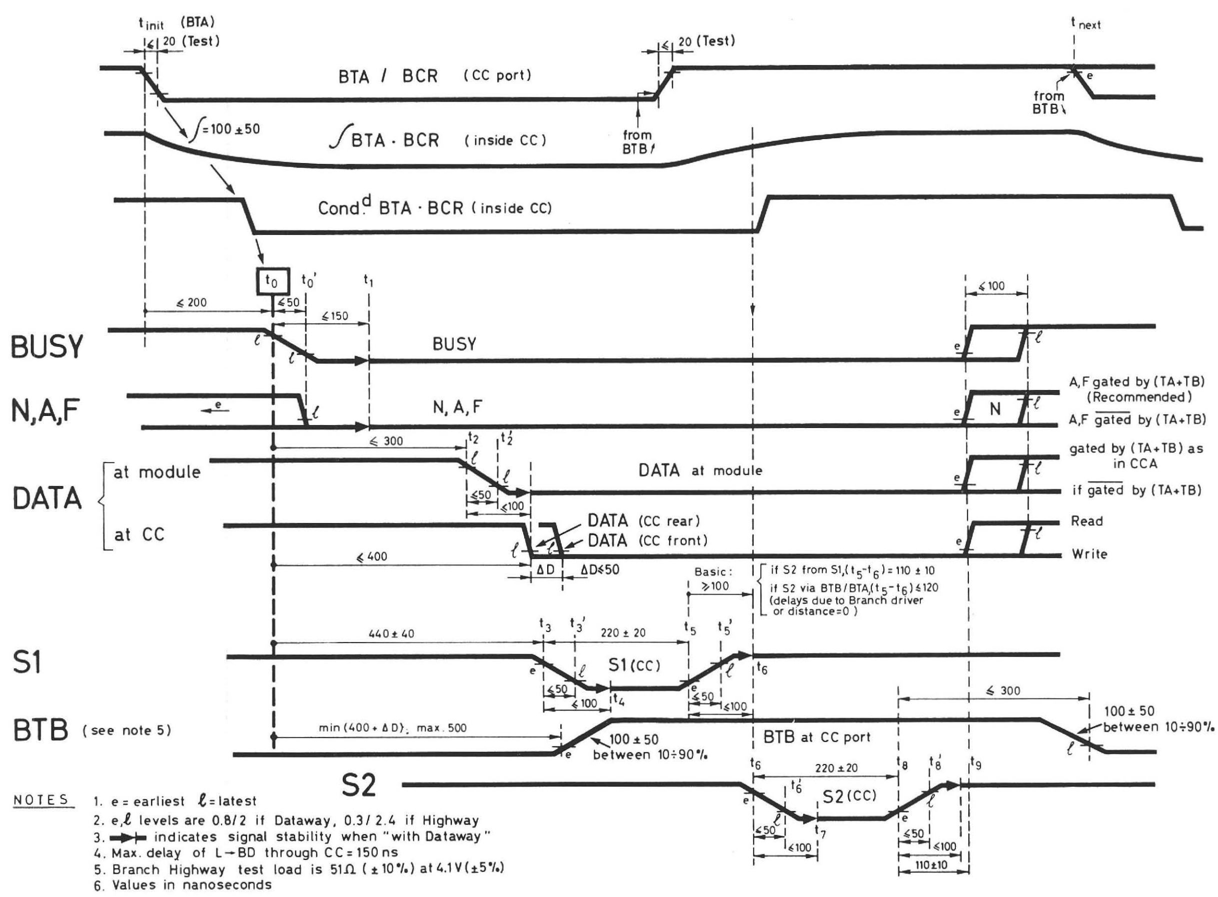



*Fig. 1 Timing diagram (Dataway/Highway/CC)*

#### Rise and Decay Times

Signals must go from '1' to '0' or '0' to '1' within 50 nsec, where '0' is 0.8 V/0.3 V and '1' is 2 V/2.4 V depending whether on the Dataway or on the Highway (see 'controlled' rise-times).

#### Shaded Areas, Ringing

The basic timing (Fig. 9 EUR 4100 e) indicates shaded areas. We have allocated 50 nsec, for rise/decay times (as above) as part of the shaded area. This leaves 50 nsec, available for possible ringing. Discussion would be long to determine by how much a slower rise/decay time would reduce ringing or vice-versa, therefore the proposal of 50/50.

Note the exception of Busy where more time is available for ringing (100 nsec due to the definition of $t_0$).

#### Definition of $t_0$

The shaded area shown in Fig. 9 of EUR 4100 e for NAF and B (Busy) creates an undefined zone of at least 50 nsec (plateau). $t_0$ is also not referred to any one of N, A, F or B in particular.

We define $t_0$ as the time when B ('0' → '1') is crossing the 2 V level (this definition has been endorsed—December 71—by the ESONE Dataway Working Group where this proposal was presented).

#### Integration Time

This is defined as the duration of the pulse (with negligible rise/decay times) necessary at the input to trigger the required action after the integration circuit. For example, in the case of ∫BTA·BCR (150 ± 50 nsec) a pulse of 49 nsec must not trigger the cycle. If the necessary minimum pulse is for example 80 nsec, the integration time is said to be 80 nsec.

#### Pre- and Post-Cycle Operation

To avoid undefined delays, in addition to integration times:

$$t_{init} \rightarrow t_0 \leqslant 200 \text{ nsec}$$

To guarantee a maximum time for the end of BTB:

$$t_8 \quad \rightarrow \leqslant \text{BTB}(1) \leqslant 300 \text{ nsec},$$

including the controlled decay time of BTB.

#### Data Delay through the CC ($\Delta_D$)

This undefined value is required to be $\leqslant$ 50 nsec.

#### Controlled Rise (decay) Time

The indicated 10%-90% for rise (decay) time values must be related to a test-voltage so that delays attached to these controlled rise (decay) time values may be defined and measured. This voltage is the 'nominal' 4.1 V (see Note 5 in timing diagram).

#### Generation of S2 BTA/BTB/BTA Operation (Time $t_5$-$t_6$)

There is a general condition that $t_5 - t_6 \geqslant 100$ nsec. To guarantee a fast working BTA/BTB/BTA operation where many delays are involved, an overall maximum delay is defined which requires that $t_5 - t_6 \leqslant 120$ nsec. This means that it is not allowed to add individual tolerances which can occur form

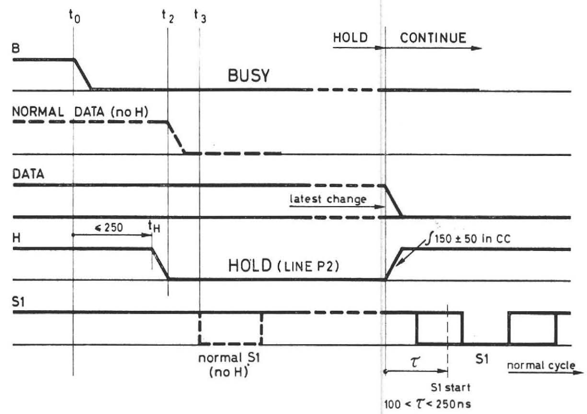



*Fig. 2 Principle of HOLD Signal Timing (definitions as Fig. 1: Timing diagram)*

$t_0$ to $t_6$ (BTB↑, controlled rise-time ∫BTA, conditioned BTA). Note that this test is made with zero external delays. If it should happen, in this case, that $t_6$ is much too early (virtually) then the basic condition $t_5 - t_6 \geqslant 100$ nsec must come into play.

## THE HOLD FEATURE (H)

The BTA/BTB handshake in the Branch Highway is not extended to the modules. It was felt necessary, or at least very useful, to be able to avoid the present cycle rigidity as produced by crate controllers, such as the A-type, since modules may want some time/freedom or flexibility when executing their command. The HOLD feature is therefore introduced in our systems and particularly our crate controllers. This HOLD feature, using only one line, allows a module (therefore a module designer!) to provide a HOLD signal to stop the generation of a Dataway operation just before S1 inside the crate controller. When the module wishes, it releases H and the operation goes on.

In case of serious errors, H may be used to trigger a time-out error routine. H is integrated in the CC to avoid a spurious start of an operation. This simple H-feature is recommended for crate controllers type A delivered to CERN.

*Note:* The *HOLD line is line P2*, obtained by bussing all (normal stations) patch pins P2. This line P2 and another line P1 were recently created (December 71) by the ESONE Dataway Working Group for individual non-standard uses. They must be provided on new crates.

1

# APPLICATION NOTES

## MULTI-CHANNEL ANALYSER SYSTEM IN CAMAC

by

D. Sanghera

EKCO Instruments Limited, Southend-on-Sea, U.K.

*SUMMARY The techniques of multi-channel analysis are well established and various hardware designs incorporating a digital computer have been implemented in the past. CAMAC offers a simple, modular and powerful analysis hardware at low cost. This paper discusses a Multi-channel Analyser System using CAMAC-compatible units and a general purpose digital computer (Honeywell H.316).*

### GENERAL DESCRIPTION

The Multi-channel Analyser System is used to acquire and analyse nuclear data, on a 24-hour basis, from up to 30 different nuclear radiation sources requiring typical counting periods of between one milli-second to one second. The basic system allows a maximum of 14K words (16-bit length) for data storage, and easy expansion by addition of backup storage media e.g., magnetic tape/disc.

The block diagram of the system is shown in Fig. 1. The nuclear radiation is detected by a scintillation detector whose pulse outputs are amplified and their amplitude then converted into a pulse train by a fast analogue to digital converter. The location in the computer store equivalent to the number of pulses in the train is incremented by one for each signal pulse. The distribution of numbers in these core-locations (channels) is then typical of the energy spectrum of the source radiation.

### SOFTWARE EXECUTIVE

The basis of the system is the real-time User-orientated Data Collection Package (UDCP). Since the package is very flexible and modular in concept, it may be used in other laboratory automation and data collection applications, e.g., process control, and data-logging.

The package consists of a real-time executive and a library of standard programs and sub-programs. It allows user modifications and program additions on demand. A separate editor is also included to enable updating of both the source and object programs. The user normally types the requirements on a master electric typewriter and then on command can see the results of the analysis either graphically on a scope/plotter or listed on an electric typewriter. Most of the standard Input/Output and Storage media available can be called on command (e.g., Fast paper-tape reader/punch, line-printer, magnetic tape/disc).

### SYSTEM FACILITIES

The following facilities are provided as standard items:

(a) Display, Print, Punch, Store, or integrate contents of channels singly, in groups, or total, during acquisition or on request. The execution of any command may be delayed by any period in the range of 100 microseconds to several weeks.

(b) Instant modification (or erase) of any or all parameters such as number of channels, number of inputs, number of groups, intensity, etc.

(c) Enable and disable of inputs (individually, in groups, or all).

(d) Dead-time and live-time facilities, coincidence and anti-coincidence feature, Upper and Lower level Discriminator, Zero Level Shift, etc.

The following facilities are provided as standard options:

(e) X-Y Recorder analogue output, Logarithmic display.

(f) Digital and Cross Correlation.

(g) Multi-channel Scaler Analysis (Isometric).

(h) Voltage Sampling Analysis (Contour).

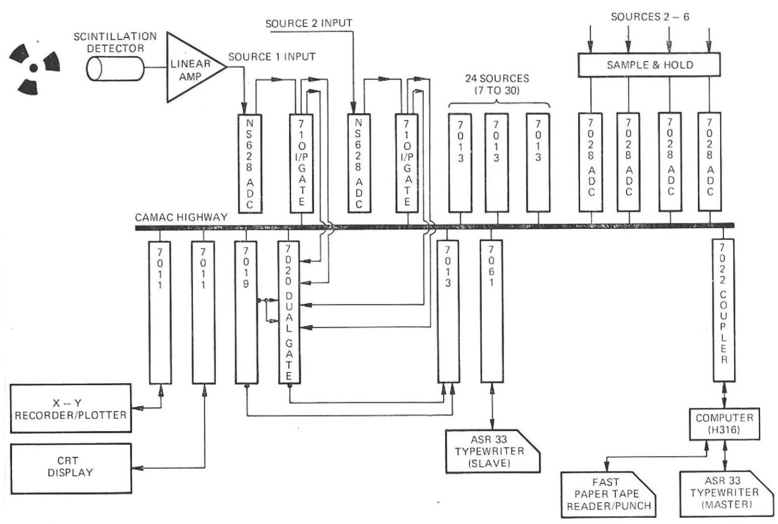



*Fig. 1 Detailed Block diagram of System 104*

2

# A COMPUTER CONTROL-SYSTEM FOR NEUTRON PHYSICS EXPERIMENTS

by

P. C. van den Berg and H. M. Rietveld

Reactor Centrum Nederland, Petten, The Netherlands

*SUMMARY This article describes a time sharing system for the computer control of one new and six existing experiments. The interfaces of the existing experiments and the complete instrumentation for the new experiments are designed according to CAMAC standards.*

## INTRODUCTION

On behalf of the neutron physics group, a computer system is being installed at the Materials Testing Reactor (H.F.R.). This system will control the following experiments:

— three-crystal spectrometer;
— ($n$, $\gamma$) experiment with oriented nuclei;
— time-of-flight spectrometer;
— ($n$, $\gamma$) angle correlation experiment;
— powder diffractometer;
— ($n$, $\gamma$) experiment with polarised neutrons;
— single-crystal diffractometer.

Except for the last experiment, which is being built, all experiments are operating automatically. They are programmed by punched paper-tape and output onto punched paper-tape.

To improve the performance of the experimental arrangements, it was decided to instal an on-line computer. Some of the aims are:

— direct feedback, e.g., counting time optimisation, peak hunting, drift correction, error correction;
— easy modification of the control program by the physicist;
— direct and better presentation of measured data;
— more backing store, e.g., the number of channels of some analysers will be more than doubled;
— anticipation of future developments, e.g., position sensitive neutron counters and multiparameter experiments need an on-line computer.

Instead of a dedicated computer for each experiment, a time sharing system was selected. The total load of tasks is such that it can be successfully handled by a single computer. No urgency situation arises, because all experiments are stable in time and therefore can be interrupted easily. The main advantage of a time sharing system is, however, that each experiment has the use of a more powerful computer with more backing-store and peripherals at lower cost.

In future some dedicated computers might be necessary as satellites of the time sharing computer for handling special tasks.

## TIME SHARING SYSTEM

The time sharing system is implemented in such a way that apparently the computer is fully available for each experiment.

A real-time monitor controls the scheduling of the users programs. When an interrupt occurs, the scheduler checks if there is another program asking for control. If this program has a higher priority than the running program, the latter is transferred to disk with preservation of status. The other program is then read from disk into core and, if it had been interrupted, its status is completely restored and the program started at the interrupt label. If there was no program with an higher priority, the running program proceeds.

The development of a good real-time monitor program is a considerable effort. To avoid this additional investment in manpower, the availability of an established real-time monitor has been the major selection-criterion for the computer. For this reason, the Philips P9205 (Honeywell H316), which has a real-time monitor (Phlex 2D) satisfying our requirements, has been selected.

In principle each experimenter will write his own control programs. To ease this task the symbolic language FORTRAN has been chosen for these programs. The programs may have a length of 5-6 K words. The device handling subroutines for the control of non-standard peripherals, such as motors, counters, analysers, oscilloscope, and magnetic tape recorder, are written in machine language and are core resident. They can be called by the main program by means of a CALL SUBROUTINE statement.

## EXPERIMENTAL ARRANGEMENT (Fig. 1)

The experimental apparatus are located around the reactor. The computer with the central peripherals is outside the reactor hall in the basement below the control room. The CAMAC system is used for interfaces and instrumentation. Three CAMAC crates with crate controller type A (CCA) are used in the system. One crate is located near the computer and contains the display driver and the character generator for the storage oscilloscope display, the recorder controller for up to four magnetic-tape recorders, a CCA, an L-sorter, the branch driver and the branch sender. A second crate, located near the experiments, contains the interfaces to existing equipment, the reversible BCD-binary converter, a CCA, an L-sorter and the branch receiver. Because of the long distance (70 m) between these two crates, a branch highway sender and a receiver module have been used to transmit differential signals. A third crate will contain the instrumentation for the single-crystal diffractometer.

The branch driver, which is also the interface between the computer and the branch highway, is designed for both programmed and autonomous transfers. The computer, Philips P9205 (Honeywell H316), has a 16 K, 16 bit core memory and a cycle time of 1.6 μs. To the computer are connected a fixed head disk of 192 K words (expandable to 384 K), a fast paper-tape reader and punch, a Calcomp plotter, a system Teletype KSR35 and seven Teletypes ASR33, located near each experiment.

## INTERFACES FOR EXISTING APPARATUS

Because the existing instrumentation is quite adequate, it is directly interfaced with CAMAC without modification. The interfacing is relatively simple because the apparatus have punched paper-tape inputs and outputs. They can operate as originally and now on-line. This makes possible a smooth switch-over to computer operation without much loss of time.

The two spectrometers and the diffractometer are of the same design, requiring only one type of interface. The interface simulates the punched paper-tape program and accepts the output of the spectrometer as it is punched. In this way, the interface can be quite simple and only minor modifications are necessary to the existing instrumentation.

For the four multichannel analysers, two different types of interfaces were required. From the computer, the analysers are now identical, except for the number of channels. The analyser interface is bi-directional, so that data can either be transferred to the computer, or retrieved from the computer for display on the analyser oscilloscope. The analyser modes can be controlled by the computer.

The data from the analyser are binary coded decimals (BCD). To avoid the time consuming conversion to binary, a hardware reversible BCD-binary converter is used. This converter is shared by all analysers. On command a data word is read from the analyser and at the same time via an external address line written into the converter. After conversion (10 μs) an interrupt is given and the binary word can be read. The converter can also be used to convert binary words from the computer for display by the analyser.

## SINGLE CRYSTAL DIFFRACTOMETER

The apparatus consists of a double-crystal monochromator with five adjustable angles (stepping motors) and a single-crystal diffractometer also with five adjustable angles (DC motors and absolute shaft encoders). There is a monitor/time preset-counter channel and a measuring counter channel. Also several relay functions, such as shutters and magnetic fields, can be controlled by the program. The set-up will be built in CAMAC and is modular in concept. Via a manual controller module, a selected motor can be set, at the same time displaying its angle. The two scalers will also have visual display.

## PRESENT STATUS OF THE SYSTEM

The non-commercially available modules have been designed and most of them are now completed. The computer has been installed and the system is being tested. The experiments will be connected successively, starting with a Laben multichannel analyser. Although the full capacity of the CAMAC system is only partially used by the existing equipment, all future expansions will be in CAMAC and therefore will be easy to realise.

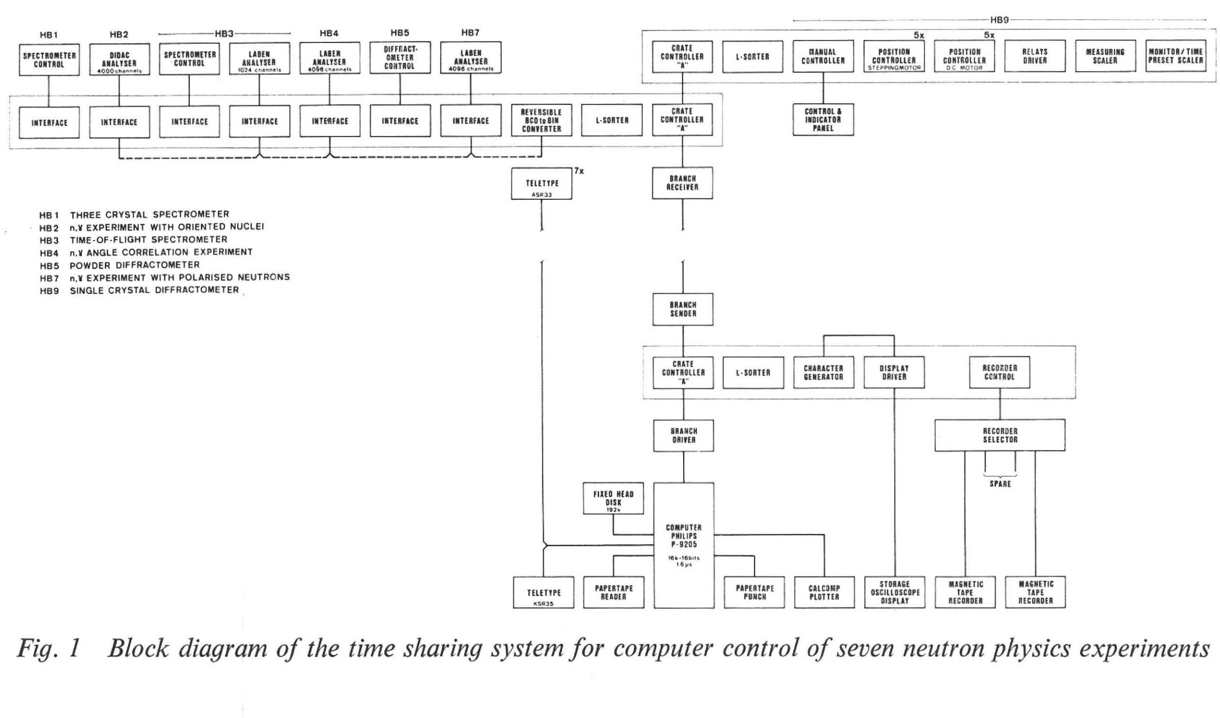



*Fig. 1 Block diagram of the time sharing system for computer control of seven neutron physics experiments*

**3**

# A CAMAC SYSTEM FOR CONTROL OF A DIFFRACTOMETER

by

A. C. Burley*, G.M. Prior*, A. M. Adams**, and E. G. Kingham**

*SUMMARY This article describes the use of CAMAC to control an X-Ray diffractometer. A CAMAC single-crate system is controlled by a dataway controller which operates on both a fixed programme set up on a plug-board and a variable programme read into the system from paper-tape.*

## INTRODUCTION

In any X-Ray diffractometer there is a requirement to measure the X-ray intensity at fixed angular positions and record the results. This can be done by scanning through the angles at a continuous rate, measuring the count-rate from an X-ray detector and recording it on a pen recorder, or by digital printout of the count taken at fixed intervals of arc. When the approximate spectral shape is known, the operating time can be reduced by programming so that coarse changes of angle are taken in regions of minor interest and finer changes in peak areas. Print-out of both integral counts in a peak and background count can be made to minimise data processing time. For some systems it may be possible to provide automatic self-programming facilities so that unexplored spectra can be rapidly assessed provided that suitable criteria are established.

A system has been designed which uses NIM modules (Nuclear Enterprises' International Series) for signal processing and CAMAC-compatible equipment for control and data acquisition. The CAMAC system uses a general-purpose digital controller operating under a fixed programme which sequentially reads in the control parameters from a paper-tape prepared in accordance with the sequence of operations required.

The system comprises standard modules which are in quantity production with the exception of a special multiple-register module built to improve the program flexibility of the system.

## SYSTEM DESCRIPTION

Analogue signals from a proportional counter mounted on the diffractometer are amplified, shaped and analysed in the signal conditioning block which outputs digital pulses for all X-rays within a selected energy-band. These units are conventional modules in NIM format and will not be described in detail. All other modules are in CAMAC format. The counter/timer section measures the count-rate by counting for a programmable, gated time period. The position controller drives the diffractometer stepping motor and so determines the position and rate of change of position of the diffractometer table. The input/output section provides interfaces for the input of paper-tape programs, and the output results as a listing or a plot and the display allows visual indication of selected functions in the system.

The overall control of the operational sequence is carried out by the system controller. Fig. 1 indicates the modules used and the operation of each block is described below.

* Nuclear Enterprises Limited, Reading, U.K.

** Central Electricity Research Laboratory, Leatherhead, U.K.

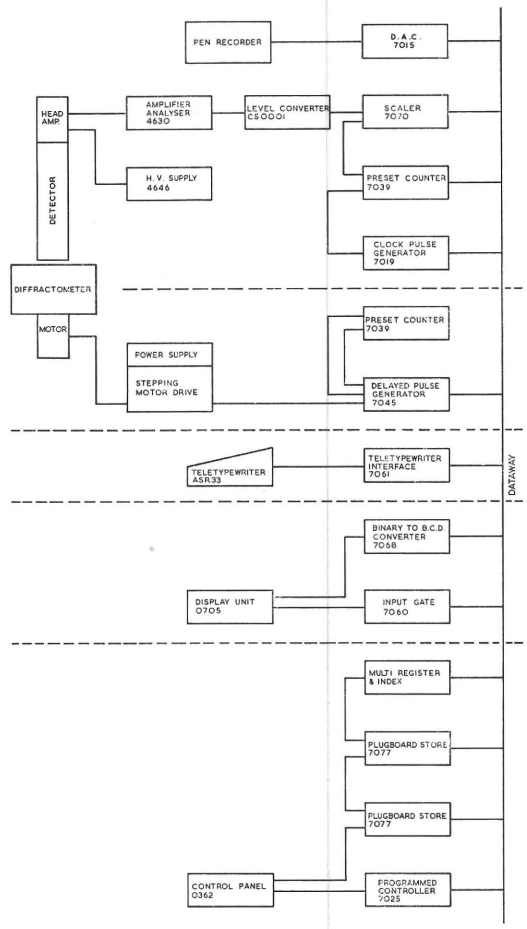



*Fig. 1 Detailed block diagram of a diffractometer system*

### System Control

The system is controlled by the Programmed Dataway Controller[1] (7025) which is instructed from a program set up on the two Plugboard Stores (7077), which allow up to 128 instructions of fixed/patchable program. The power of the instruction set has been greatly extended by the use of the Multi-register and Index module. The unit contains four indexing or instruction-modifying registers which may be patched to be accessed from any part of the fixed program. This allows certain parameters, e.g., Station, Sub-Address and Shift to be modified, so that program loops may be set up, thus improving the efficiency of the program and reducing the plug-board space required. The Multi-register also contains other fixed registers which are used to store various parameters required at different parts of the program.

The controller is instructed to read the experimental parameters from the punched paper-tape and transfer the data to the registers which are used in the program for controlling the stepping-motor driver, counter timing and output of results. In this way a flexible program facility is offered. The operation of the 7025 is controlled and monitored by the Control Panel (0362) which may be used to set up the different modes of operation.

## Counter/Timer

Digital pulses from the signal conditioner, after conversion to CAMAC signal standards, are stored in the Counting Register (7070) for a time determined by a gate pulse, of programmable width, generated by a Preset Counting Register (7039), which is decremented to zero from a preset number by clock pulses from the Clock Pulse Generator (7019). When zero is reached, counting in the 7070 is inhibited and an L-signal generated by the 7039 initiates a print-out cycle.

### Position Controller

The Delayed Pulse Generator (7045) produces pulses, at a programmed rate, which index the stepping motor of the diffractometer via the Stepping Motor Drive unit. The number of pulses and hence the angular change of position is determined by a second 7039 which is set to the required number of pulses and decremented to zero by the output pulses from the 7045.

### Input/Output

The Teletypewriter Interface (7061) gives a bidirectional interface to the ASR 33 Teletypewriter which provides a paper-tape input facility and a print-out of results. The count accumulated in the 7070 may also be supplied to a pen recorder after conversion via a Digital to Analogue Converter (7015).

### Display

Any register in the system may be selected by setting its station number and sub-address on front-panel switches on the Display Unit (0705). This command information is fed into the program via an Input Gate (7060). Data from the selected register are converted from binary to binary-coded decimal by the converter (7068) and displayed on decimal indicators on the 0705. The 7068 is also used to convert data for decimal print-out.

## SYSTEM OPERATION

There are two basic modes of operation—'tape-controlled' and 'self-programmed'. A continuous-scan operation is simply a particular case of the 'tape-controlled' program.

### Tape-Controlled Mode

The control tape prepared by the operator gives information on system parameters in the format given below:

xxx Sp xxxx C.R.L.F.
xxxxx Sp xxx Sp xx Sp xxxxxx Sp xxxxxx C.R.L.F.
xxxxx Sp xxx Sp xx Sp xxxxxx Sp xxxxxx C.R.L.F.
etc.

The first line is the tape indent, Sp indicates a space and Carriage Return Line Feed initiates read-in of program information. The tape indent can be modified by the sample number and reflected to provide hard copy e.g., ALV 1256-01, where 01 is the sample number and ALV 1256 is the program identifier.

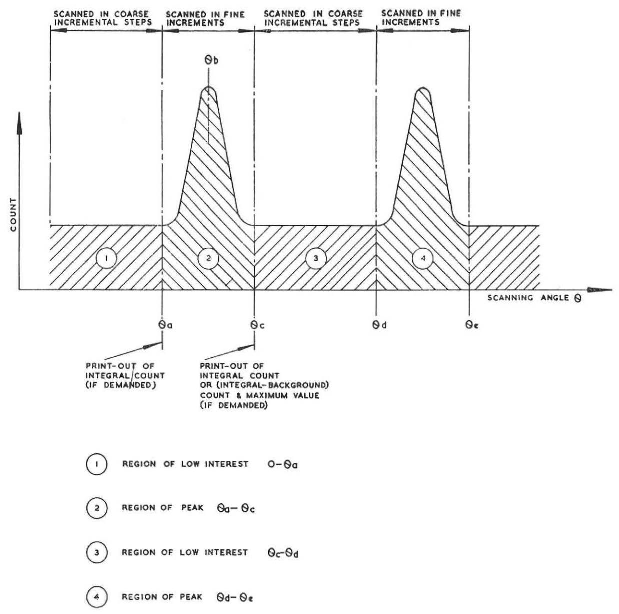



*Fig. 2 Scanning response*

The format of information is:

First block — Angle to which the goniometer will move (decimal or octal).
Second block — Specifies angular step increment as multiples of .001° in octal.
Third block — Speed of rotation in octal (delay values).
Fourth block — Preset time written as octal value in milliseconds (6 characters).
Fifth block — Limit of count in octal (6 characters).

A program demand character, e.g., P, at the end of a line will initiate a print-out of the integral and peak values and clear the appropriate registers at the end of the programmed scan.

System operation is initiated by a start button on the 0362 and the first block of information is read in from tape. The diffractometer is moved to the starting position and readings are taken at the prescribed intervals and printed-out until the angle (θ) defined in the first block is reached. The integral count appropriate to the data block is then read out if required and the next block of data read in.

Fig. 2 shows a typical sequence where it is possible to increment from 0 to θa giving a print-out of angle and count after each increment. A demand at θa would initiate a print-out of the integral background count. The segment of arc θa to θc may be scanned then in a continuous movement or by incremental steps. At θc, a demand would initiate print-out of the integral count in the peak, together with the peak value and the peak angle θb. A scan over θc to θd could similarly be performed.

The print-out consists of five decades to specify angle and five decades for count. The angle may be suppressed after the first reading of block if required e.g., 12901 59464 60746 .........C.R.L.F.

On 'print demand', a print-out of the first reference angle, second reference angle and the integral count between these angles will be output
e.g., xxxxx Sp xxxxx Sp xxxxx C.R.L.F.
θ1 θ2 Integral Count

where θ1 and θ2 are the angles between which the integral count is taken.

### Self-Programming Mode

This mode can be initiated by starting the program from an alternative instruction address. The angles are scanned at a predetermined rate and edges of the peaks are determined by detecting the points at which the count-rate first doubles and then halves. A program tape is generated consisting of the angular positions of the peak and the incremental scan value and rate.

### REFERENCE

1. A programmed controller in the CAMAC system by L. D. Ward, G. S. L. Mitchell and J. M. Richards. AERE R-6334.

*Note:* This is a preliminary report on a system whose modification, operation and application at CERL, will be published in due course.

# NEWS

## ANNOUNCEMENTS BY CAMAC MANUFACTURERS

**DORNIER AG** (Germany) has announced that they are now able to supply CAMAC modules for process control peripherals, laboratory automation and routine testing. This reflects the company's opinion that CAMAC can be successfully applied to laboratory automation in universities, research centres of the medical and pharmacological industries, in testing associated with engines and electronic equipment production. Among the equipment available are A-to-D converters, with a resolution of up to 15-bit and conversion times down to 10 μsec multiplexers for high- or low-level signals either single-ended or having differential inputs, D-to-A converters, of output $\pm 10$ V, 20 mA fully protected up to $\pm 15$ V and against short circuit, and digital modules having optically-coupled inputs and reed-relay outputs.

Dornier are offering their small process control computer system which employs the 8-bit MULBY computer and a special crate controller (Type D) which combines the functions of system and crate controller. The type D allows program-controlled transfers and collects and handles LAM signals. Up to 12 crates may be connected to the computer although, normally, systems will consist of only a few crates. In this low-cost version of the system, the computer peripherals will be a teletype and an alpha-numeric display. A basic operating system has been developed which may be controlled via teletype or keyboard and display. The operating system organizes up to 100 user programs according to a simple priority system, it processes input and output data including the handling of the interrupt system, it produces a log output and it starts and stops the internal real-time clock. Possible commands include parameter modifications for individual user programs.

Dornier specialists are prepared to develop user programs quickly by programming with a large computer system which outputs an object program on paper-tape to be loaded with a link-loader.

Dornier also supply connector panels which can be mounted in the rear of 19 inch. racks to provide a simple means of connection for analogue and digital signals between the process and the control system.

**NUCLEAR ENTERPRISES LIMITED** (U.K.) has a CAMAC Interface to the PDP-11 computer in an advanced state of development. The Interface can be built up from three units:

Computer Controller Type 9030
Branch Interface Type 9031
PDP-11 Interface Type 9032

The 9032 plugs into the 9030 and is an option specific to the PDP-11. This combination provides single crate operation. A multicrate system can be configured using the Branch Highway (EUR 4600) driven by a 9031 coupled with the controller. By this means, an economic solution is provided for both single and multi-crate systems. Facilities are included for addressing up to four branches, thus giving an addressing capability for 29 crates.

In addition, the existing range of controllers for the H.316, DDP-516 and PDP-8 family of computers is being extended by the development of a PDP-8 Databreak Interface module which features Add 2/Increment/Transfer to an addressed memory location.

**TECHCAL ELECTRONIC SERVICES** (Canada) is now offering scalers, control modules input registers, D-A converters, master and slave branch highway drivers for a NOVA computer as part of their recently introduced range of CAMAC equipment.

**JORWAY CORPORATION** (USA) is extending their range of CAMAC equipment. A teletype interface unit and a 200 MHz scaler are being developed and their Crate Controller Type A is being redesigned to the modified specifications. The company is investigating signal characteristics such as transition times, overshoot and undershoot on both the Dataway and Branch Highway. Some additional modules for use in control applications are under consideration.

**ZJEDNOCZONE ZAKLADY URZADZEN JADROWYCH POLON** (Poland) has announced, recently, that they are manufacturing crate frameworks, powered and wired crates and unit frameworks.

# (1) DEVELOPMENT ACTIVITIES

## A STANDARD PORT FOR COMMUNICATION WITH CAMAC PERIPHERALS

by

H. Klessmann, H. Pangritz, and W. Wawer

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

*SUMMARY Frequently in CAMAC instrumentation systems, external, non-CAMAC equipment is employed which either cannot be, or has not been, designed according to CAMAC standards. In general, these 'peripheral' units can be linked with the CAMAC system by means of standard input or output modules which provide a simple, but versatile, digital port for 24-bit parallel data transfers. The port enables handshake control of the data transfers to ensure synchronisation with the speed of the peripheral, where this facility is provided. Additional signals are provided for very basic control functions only. This digital port for communication with CAMAC peripherals is defined to be compatible with the relevant specifications of EUR 4100e. It has been introduced as a laboratory standard at HMI Berlin and presented to the German 'Studiengruppe für Nukleare Elektronik' as a guideline for designers of computer-controlled external equipment.*

*In the meantime a recommendation for the interface between CAMAC modules and external instruments has been adopted by the 'Deutsche Studiengruppe fur Nukleare Elektronik' and instruments are in production or under development by several manufacturers. This recommended interface is similar to the proposal of the Hahn-Meitner-Institute, one of the differences being the use of a 37-pole single density Cannon-connector.*

### INTRODUCTION

In many CAMAC instrumentation systems, data or control information have to be transferred to or from external, non-CAMAC equipment. These 'peripheral' devices may be, for example, high precision analogue instrumentation like AD-converters, computer-controlled amplifiers, discriminators, time-to-pulse amplitude converters and display units, or electromechanical devices like paper- or magnetic-tape drivers, key boards, stepping motors for control of the experimental set up, etc. Most of these devices can be linked with the CAMAC system by means of a standard scheme for parallel digital data transfer whereby interfacing problems are very much reduced.

### SIGNALS

For reasons of simplicity of interconnection and associated logic, separate ports are used for input and output transfers, and a very limited number of signals employed:
24-bit Data / Request / Acknowledge / Reset Periph. / Status Periph. / Status CAMAC / 5 Non-standard Signals/4 Power Supply lines for Peripheral.

Up to 24 bits of DATA may be transferred in parallel on uni-directional lines, assuming that short distances ($\leqslant 10$ m) and individual interconnections between peripherals and the CAMAC system are the normal case. Each data transfer is controlled by timing signals REQUEST and ACKNOWLEDGE in a handshake mode which is described in more detail in the following section. By means of a RESET signal the peripheral may be set into an initial state, as may be necessary after switching on power or after any unusual condition.

Two other signals are used to indicate the operating condition of the peripheral and the CAMAC module respectively:

— STATUS PERIPHERAL signal = HIGH = Logic '0' = peripheral not operating. This condition, received at the CAMAC module, may occur if:
  - the peripheral is not connected to CAMAC.
  - the power supply of the peripheral is off.
  - the peripheral is in off-line mode (manual control).

— STATUS CAMAC signal = HIGH = logic '0' = CAMAC module not operating. This condition, received at the peripheral, may occur if:
  - the CAMAC module is not connected.
  - the peripheral is permitted to be operated off-line.

In both cases the peripheral may be controlled manually.

The NON-STANDARD lines may be used for additional signals if special peripherals require dedicated CAMAC interface modules. Examples are Parity, Parity Valid, End of Block, Overrange, etc.

The POWER SUPPLY lines may be used for peripherals such as keyboards which contain some logic circuits or indicators with small power consumption.

### TIMING

The handshake mechanism is similar to the Branch Highway timing and is based on this principle:

— The transmitter indicates 'data ready for transfer' to the receiver.

— The receiver indicates 'data accepted' back to the transmitter.

For DATA INPUT (see Fig. 1) the peripheral establishes data (data ready, phase 1) and requests a data transfer by REQ = '1' (phase 2). The CAMAC module responds by Acknowledge signal ACK = '1' and accepts data (phase 3). After receipt of ACK, the peripheral removes REQ (generates REQ = '0', phase 4) upon which the CAMAC module generates ACK = '0' to indicate that data have been accepted, the transfer is terminated, and that another input transfer may be requested.

For DATA OUTPUT (see Fig. 2), the peripheral (as with data input) requests a data transfer by REQ = '1' (phase 2). The CAMAC module establishes data (data ready) and responds by Acknowledge signal ACK = '1' (phase 3). On receipt of ACK the peripheral accepts data and removes REQ (generates REQ = '0', phase 4) upon which the CAMAC module generates ACK = '0' to indicate that the transfer is terminated and that another output transfer may be requested.

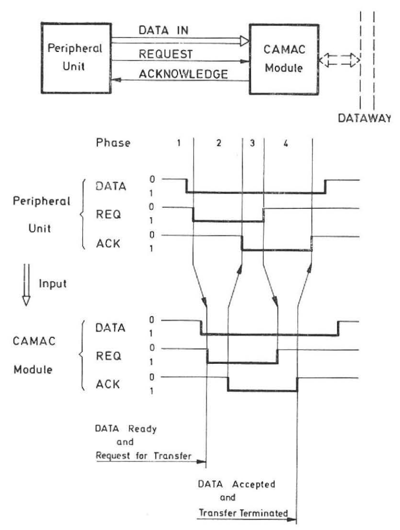



*Fig. 1 Timing Diagram for Data Input Transfer*

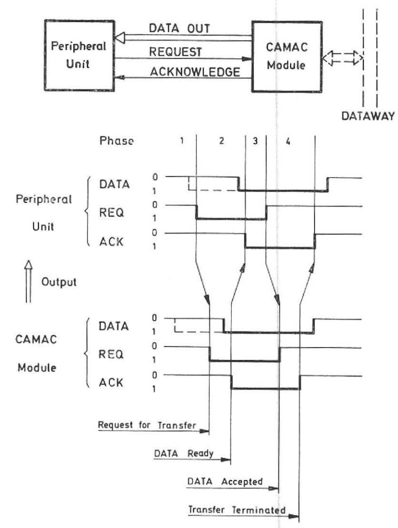



*Fig. 2 Timing Diagram for Data Output Transfer*

This handshake scheme of data transfer operates with any cable length and any internal delays of the transmitter and receiver and, effectively, ensures synchronisation with any speed of the peripheral. If simple peripherals do not require this handshake mode, data may be transferred by means of a strobe signal on the Request line. Finally a continuous data transfer—i.e., setting latches without coincidence with a strobe—may be performed if the Request line maintains the low-state (logic '1') permanently.

## SIGNAL STANDARDS

The signal standards specified in EUR 4100, Table VIII, for unterminated signals have been adopted; the voltage levels conform to TTL standards, and logic levels are defined by logic '1' = LOW STATE, so that disconnected inputs = logic '0' = HIGH STATE.

Balanced-line transmission was rejected for this application in spite of its high noise-immunity (due to common-mode rejection at the receiver input and low susceptibility to circulating ground currents), its low cross-talk (due to low signal amplitudes) and its long-distance capability (due to low line currents). Asymmetric signals were accepted because of low cost, because it was assumed that, in general, distances less than 10 m are involved and because peripherals frequently present TTL- and DTL-inputs or outputs.

High-speed data transfer requires that the lines are terminated in order to eliminate signal reflection. This, however, implies

- high currents for the driver and in the termination at the receiver (more than 30 mA per line, more than 700 mA per cable);
- definition of new current standards additional to those already specified for unterminated signals;
- peripherals with standard TTL- and DTL-outputs do not provide sufficient current sinking capability.

For these reasons signal conventions for unterminated lines seem preferable. Moreover the handshake timing permits reliable transfer of data since signals can be delayed until reflections have settled.

## CONNECTOR

The port uses the 52-way CANNON Double-Density connector as already defined in EUR 4600 for Crate Controller Type A, i.e., fixed member with pins (Type 2 DB 52 P), mounted on the front face of the front-panel to allow locking assemblies and with pin 1 lowermost. Pin 52 carries earth potential and screen.

The pin allocation shown in Table 1 indicates that line-pairs are used for timing and control signals to decrease noise sensitivity. Cross-talk on data lines is less critical since timing allows data acceptance after signals have settled.

*Table 1 Contact Assignment of 52-way Connector*

| Contact | Usage | Contact | Usage | |
|---|---|---|---|---|
| 1 | Request | 2 | 0 V | ) Timing |
| 3 | Acknowledge | 4 | " | ) |
| 5 | Reset Periph. | 6 | " | ) |
| 7 | Status " | 8 | " | ) Control |
| 9 | Status CAMAC | 10 | " | ) |
| 11 | $2^0$ | 12 | $2^1$ | ) 24 Bit |
| . | . | . | . | ) Data |
| . | . | . | . | ) |
| . | . | . | . | ) |
| 33 | $2^{22}$ | 34 | $2^{23}$ | ) |
| 35 | Nonstandard | 36 | 0 V | ) |
| . | " | . | " | ) |
| 43 | " | 44 | " | ) 5 Nonstandard |
| 45 | + 6 V | 46 | | ) |
| 47 | - 6 V | 48 | | ) Power Supply |
| 49 | +24 V | 50 | | ) |
| 51 | -24 V | 52 | 0V,Screen) | |

(2)

# MONICA
# INTERFACE – MODULE CONTROLLING NIM VIA CAMAC

by

W. Kessel, G. Rüschmann, and R. Staudte

Institut für Kernphysik Universität Frankfurt/M., Germany

*SUMMARY A CAMAC module is described that delivers both analogue and digital signals to an external device. In addition to two 12-bit output registers, two independent analogue-outputs with 10- and 12-bit resolution via a current-source are provided. The intention is to control different NIM modules or other external devices by a computer via CAMAC without the necessity of having expensive DAC's and registers in the devices themselves. The general idea as well as the technical data of the module are given.*

## GENERAL

CAMAC is an effective interface system between measuring equipment and a computer. The information may flow in both directions to form a closed loop. In nuclear electronics the signals from radiation detectors pass through a series of instruments (e.g., amplifiers, discriminators, coincidence-units and analogue-to-digital converters) before they enter the data-processing station. Here again the goal of CAMAC is to control the experiment in a closed loop. One possible solution could be to establish all instrumentation in CAMAC. In our opinion, it will take years for a complete set of instrumentation to be available in CAMAC and anyhow, in general processes, there always will be external devices at the front end. On the other hand, many existing devices are already equipped with control inputs that require either digital and/or analogue signals to be applied. It should therefore be useful to have a link between CAMAC and external devices.

The first step in this direction has been taken, naturally, with digital signals. Many digital input and output registers are already available[1]. The CAMAC module described in this paper supplies both digital and analogue signals. An ADC, for example, may be controlled by digital signals to switch different modes of operation and by analogue levels to set the baseline and the slope of conversion.

A review of the instrumentation on existing experiments revealed that two analogue outputs with a resolution of normally 10-bits and, at most, 12-bits in addition to two 12-bit digital outputs should cover most of the problems. On this basis a CAMAC module was developed for control of external-to-CAMAC instruments.

## ANALOGUE SIGNALS

To substitute for the high resolution of a ten-turn potentiometer, a digital-to analogue converter (DAC) of at least 10 bits is necessary. In order to retain the resolution of a 12-bit DAC, the transmission of these signals demands a signal-to-noise ratio of $\geqslant 80$ dB. An intensive discussion of the different possibilities led to the following solution[2]. The output voltage of the DAC is converted into a load-independent current by a current source. This eliminates the influence of probable potential differences in the ground loop between the two systems. The load is located in the external device (e.g., NIM module) and should be 1 k.ohm. It is necessary to realise a current source with an output-impedance $> 10$ M.ohm to obtain sufficient noise suppression. Because of the output capacity, this could be achieved only up to 1 kHz. At higher frequencies integration at the input of the current receiver yields noise suppression. The settling time, to an error of $10^{-3}$, after a full scale step change is $< 0.5$ ms; which is certainly short enough for the intended application.

## DIGITAL SIGNALS

The two 12-bits of digital information are available via sub-addresses A(1) and A(3). The output levels are open-collector circuits which must be terminated at the input of the external device and pull-up to +15 V. Negative logic is used, so that the cleared registers show high level at the output. In accordance with a decision within Studiengruppe Nukleare Elektronik[3], the digital signals are connected to defined locations of a 37-pin Cannon D-connector. The signals may be either used as a series of one-bit-switches or as a bit-pattern.

## DATAWAY OPERATIONS

In the module the following tasks must be handled:

(a) Enable—Disable.

(b) Data-transfer from dataway to module (Write).

(c) Test Status of the module and the external device.

(d) Data-transfer from module to dataway (Read).

Therefore the CAMAC commands used are:

| | |
|---|---|
| Overwrite Group 1 Register | F(16) |
| Test Status | F(27) |
| Clear Group 1 Register | F(9) |
| Disable | F(24) |
| Enable | F(26) |
| Read Group 1 Register | F(0) |

The status register in sub-address A(14) can be read with F(1) onto Read lines R1 to R8. R1 to R4 gives information about the status of the external device; R5 to R8 gives the status of the sub-addresses A(0) and A(3). Fig. 1 shows a block diagram of the module.

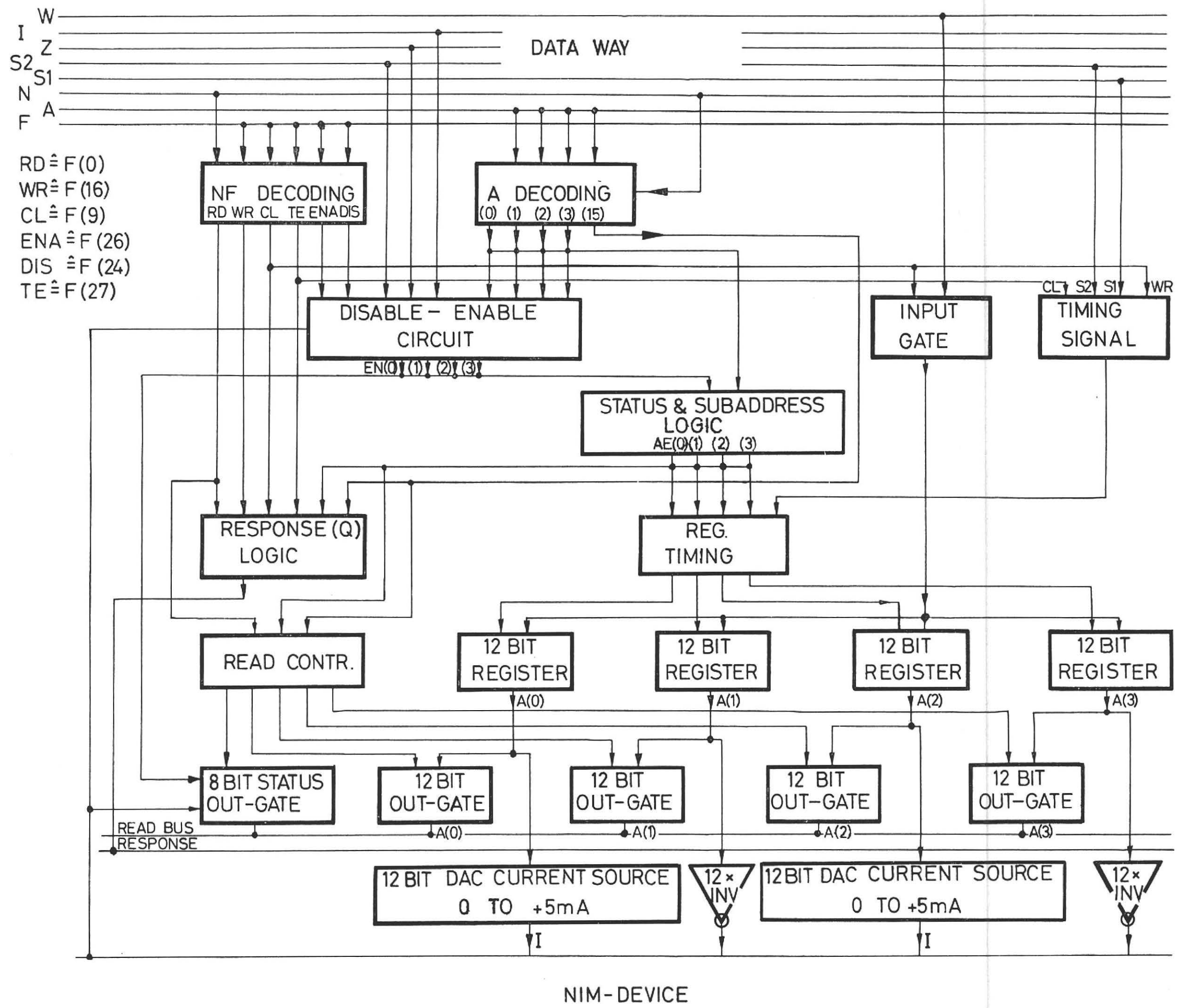



*Fig. 1 Interface Module, Block Diagram*

## THE MODULE

A prototype of MONICA has been built and is undergoing test. The circuits fill one CAMAC board and are handwired and for reasons of convenience, the module is two units wide. Recently, DAC's with 12-bit resolution are available now as a set of dual-in-line packages, so that this circuitry can be realised easily in a single-width unit.

The analogue signals are supplied via insulated coaxial connectors. In accordance with the CAMAC analogue signal standards the range is 0 to +5 mA, which gives the recommended value of +5 V in a 1 k.ohm load. The CANNON D-connector is on the front panel.

## CONCLUSIONS

MONICA is a CAMAC module that supplies external-to-CAMAC instrumentation with both digital and analogue signals for control of its operation. Between the two extremes of pure CAMAC instrumentation and registers and DAC's in each external device, MONICA could be an efficient link. With the features as described, it should be able to control for example a great deal of NIM modules which are capable of control by external signals. In smaller laboratories, dealing with low-energy nuclear physics, this could be a great help in the near future.

## SPECIFICATIONS

**Use of dataway:**

| | | |
|---|---|---|
| Sub-Address | A(0) | 12-bit DAC |
| | A(1) | 12-bit Digital Information |
| | A(2) | 10-bit DAC |
| | A(3) | 12-bit Digital Information |
| | A(14) | Status Register |
| Function Code | F(0) | Read Group 1 Register |
| | F(9) | Clear Group 1 Register |
| | F(16) | Overwrite Group 1 Register |
| | F(24) | Disable |
| | F(26) | Enable |
| | F(27) | Test Status |
| Status Signals | Q | |

Common Control Signals I, Z.

## Dual-Slope ADC

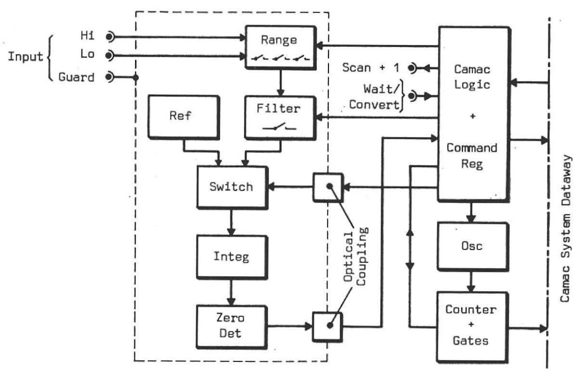
The Dual-slope ADC Type 1241 is a CAMAC unit intended for operation as a digital voltmeter for thermo-couples and strain gauges as well as general purpose applications. Range settings of $\pm 100\,mV$, $\pm 1\,V$ or $\pm 10\,V$ can be controlled directly by the computer. Readout is 12 bits (including sign) in two's complement code, i.e., 0.005% accuracy.

Conversion is achieved using the dual slope principle with an integration time of 20 ms for maximum rejection of interference from mains frequency pick-up (16 2/3 ms upon request for 60 Hz operation). The complete analogue section of the instrument is electrically isolated from the digital part for a high common-mode rejection. A computer-switchable filter is included in the input for the rejection of unwanted transients, etc.

Considerable operational flexibility is obtained by the use of a Command Register, loadable from the write lines of the system dataway. Many differing combinations of operational modes can thus be commanded in a single CAMAC cycle.

A single ADC Type 1241 will work in conjunction with up to twenty 15-Channel Multiplexers Type 1701 for data scanning operations. The 'convert' command can be given either by an external source, such as the Multiplexers themselves, or from the dataway.

Delivery: Autumn 1971




***Ref. Borer & Co.***

## CRATES, SUPPLIES

### Powered Crate with Supply Control Features

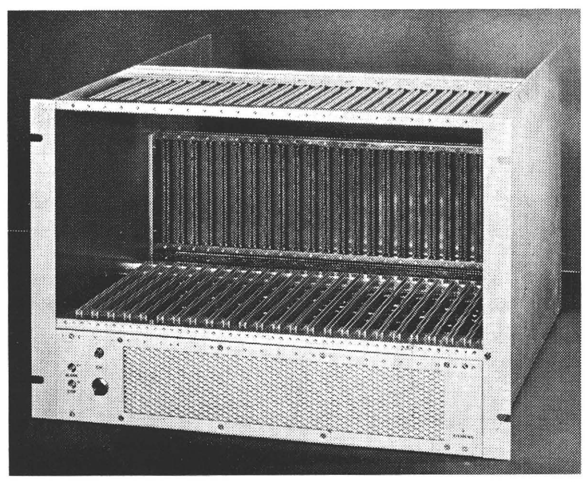
A 7U high powered crate with ventilation equipment is offered. The power supply is plugged-in at the rear side of the crate.

The bottom part of the crate (2U high) is equipped with low noise blowers and a dust filter and has a front panel section for power supply control.

The ventilation system is very efficient. Even under worst case conditions the maximum temperature in plug-in units will not exceed 15 °C above ambient (dense packing of crates and plug-in units, this plug-in units at most unfavourable locations within crates, maximum power dissipation, per crate 200 W, per station 8 W).

For the Dataway, printed-circuit and wire-wrapping techniques are applied. The lines $S_1, S_2$, are handled separately to reduce cross-talk.

The power supply delivers all mandatory and recommended voltages up to a maximum power output of 200 W; power distribution is limited only by the current rating specified for the different voltages. In case of an overload the individual supply voltage is switched off. After termination of the overload the respective supply will be switched on again if an automatic start circuit is enabled. An 'alarm' signal (TTL level) is available at a front-panel socket as long as one or more supplies are overloaded. All low voltage supplies together will be switched off under different conditions: 1. their overall power output exceeds 200 W; 2. an external TTL signal is delivered to a 'stop' input; 3. the 'alarm' signal is transferred to the 'stop' input, directly or delayed via external control circuits (e.g., to store somewhere the fault condition and (or) to perform important operations before switching off).



*Specifications*

+ and − 6 V/26 A, Ri < 1.2 mΩ
+ and −12 V/ 6.5 A, Ri < 2.4 mΩ
+ and −24 V/ 6.5 A, Ri < 4.8 mΩ
+ 200 V/ 0.1 A, Ri < 50 Ω
optional: 117 V AC, 0.5 A
Line Voltage: 220 V (+10%, −15%)
Line Frequency: 45−63 HZ
Current Load: < 2.4 A
Ambient Temperature: 0 to 50 °C
Weight: Crate, 12 kg
Power Supply, 12 kg

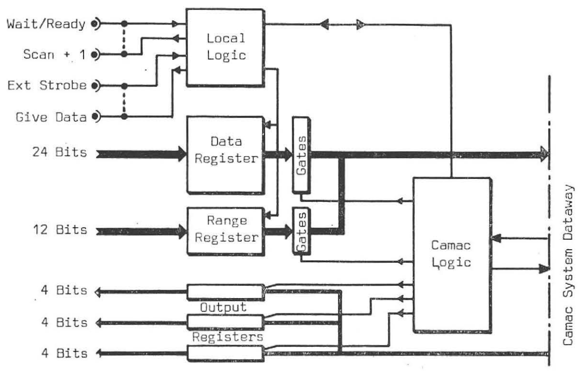
***Ref. Siemens AG***

### CAMAC Power Supply (Model #1410)

This power supply meets or exceeds the specifications as outlined by the AEC and Lawrence Radiation Laboratory, U.C. Berkeley per 'specifications for a typical CAMAC power supply' dated August 24, 1971. This power supply also includes a blower section to deliver the cooling air required for the modules as well as the power supply.

Facilities are included by which a 'Give Data' command can be given to the connected instrument during which time the output information (i.e., range, etc.) cannot be changed. The available input information is then strobed into the 24+12-bit registers by an external strobe. Optionally, the 1031 can be made self-strobing. Compatible operation is also possible with the Borer 15-channel Multiplexer Type 1701 since the 1031 is able to give the necessary Scan+1 signal and receive the Ready signal. Optionally the Ready signal can be generated internally from the Scan+1 command when the 1031 is not being used in conjunction with a Multiplexer.

Delivery: Autumn 1971




***Ref. Borer & Co.***

### Step Motor Driver

The Step Motor Driver Type 1161 acts as an interface/driver for the control of multiturn potentiometers, positioners, etc., in plotters and probe frames directly by a computer.

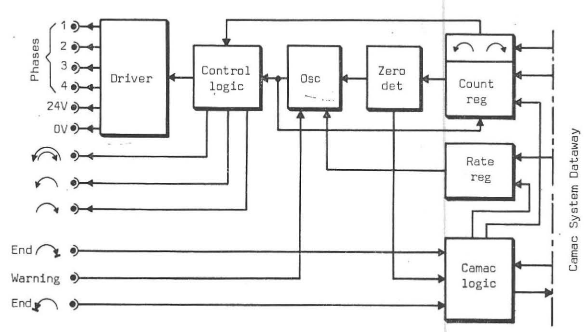
The required number of steps and the neccessary direction of rotation can be written into the driver quite separately from the stepping rate; all such commands being under program control. A maximum count of 32'768 may be pre-loaded while the stepping rate itself is programmable from a choice of 15 steps in the start/stop range with a further step for the slew range under controlled acceleration conditions.

Working on a count-down principle, the motor will run until the step-count register is empty. A 'stop' can be commanded during the count-down without disturbing the remaining content of the register when the motor will wait until commanded to 'go' again to complete the pre-determined count.

Manual command of the motor is also provided by means of push-buttons. This is especially useful during the setting-up and programming phases of an installation as well as for maintenance purposes.

Input connections are provided for left/right limit switches as well as for a prewarning of the approach to a limit. Outputs from the module are four phase signals (each capable of sinking up to 500 mA), +24V and direction signals for applications requiring a further driver stage. The module is fully compatible with the electrical, mechanical and logic standards of the internationally approved CAMAC system.

Delivery: Autumn 1971




***Ref. Borer & Co.***

## MULTIPLEXERS, CONVERTERS

### 15-Channel Multiplexer

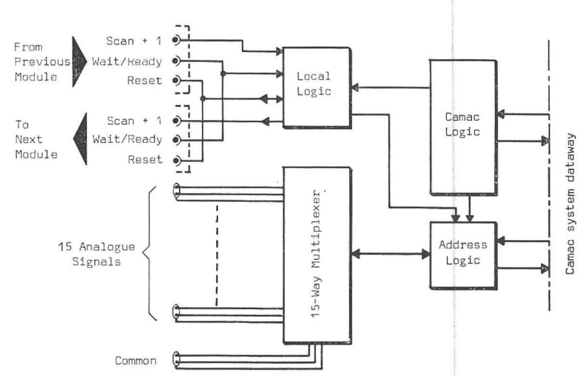
The Multiplexer Type 1701 provides a very convenient means of switching up to 15 analogue signals to a single ADC or DVM. The 1701 is a general purpose instrument especially useful for the relatively low-speed switching of thermocouples, strain gauges, etc. Each channel has a 3-pole switch thus permitting floating signals and guarding techniques to be used.

The design of the module is such that as many as 20 modules, i.e., 300 channels, may be operated together through a simple arrangement of bus-lines linking each module in conjunction with a conventional CAMAC system.

Operation is possible in either a direct-access mode, when each channel is individually addressed from the dataway, or in a scanning mode. In this latter mode each channel (from a specified starting point) in a module is opened successively in response to a 'Scan+1' command. On reaching channel 15, a module resets itself to channel 0 and passes all further 'Scan+1' commands on to the next module, etc. Scanning continues in this mode until a pre-determined end channel is reached.

When a new channel is opened in any particular module, all other multiplexers in the system are automatically reset to channel 0. All modules in a system produce a brief 'Wait' signal on a common bus-line when a channel is newly opened to allow all disturbances to subside before a measurement begins.

Delivery: Autumn 1971



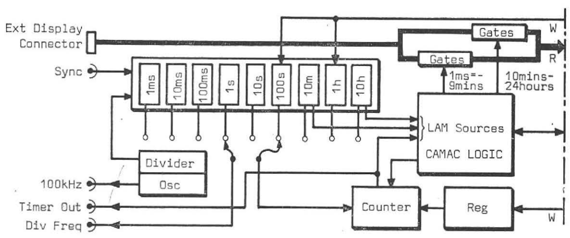

***Ref. Borer & Co.***

matically. In the second case a command from the dataway is required to reset and restart the count-down. The register content remains unchanged until overwritten.

Besides the LAM from the timer output, the clock can also be commanded to generate a LAM every 10 minutes and/or each mid-night as required.

Front panel connections prove (*a*) a 100 kHz pulse train (*b*) a pulse train of scaled-down frequency (factor according to choice) and (*c*) an output signal from the time after the chosen elapsed time.

Delivery: Autumn 1971



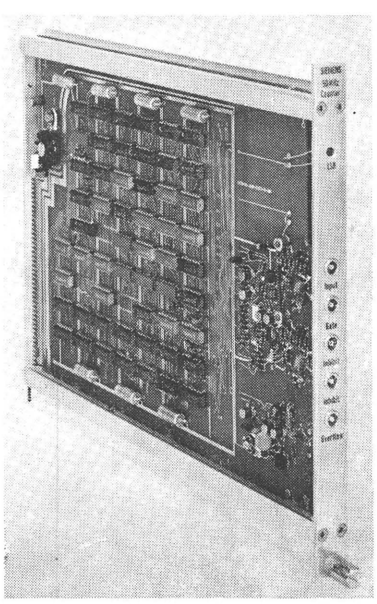

***Ref. Borer & Co.***

---

## 24-bit Preset Scaler

The scaler is designed for a counter-timer-system working in preset-count and/or preset-time operation.

It contains within a single-width module the 24-bit binary counter, a 24-bit readout register and a special overflow processor. The scaler is preset via the write lines of the Dataway. Readout is possible at any time without interrupting the counting operation. On the front panel there are 3 coaxial connections: INPUT (50 ohms), GATE (50 ohms) and INHIBIT (TTL); on request INPUT (TTL) is available. Current and/or voltage of the input signals will correspond to EUR 4100. The input resolution is $18 \pm 2$ ns and the delay between INPUT and GATE less than 5 ns.



The module is designed according to specifications set out by 'Gesellschaft für Kernforschung, Karlsruhe'.

***Ref. Siemens AG***

---

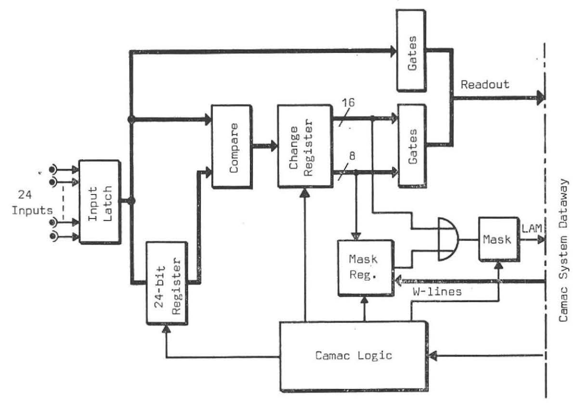
## 24-bit Status Change (Alarm Register)

The CAMAC module Type 1051 is designed to permit up to 24 alarm or similar circuits to be continually monitored and to notify the computer if any change occurs. The input circuitry is suitable for the direct connection of relay or similar contacts located remotely from the module. It is also an excellent means for connecting Carryplex receivers associated with a very randomly scattered surveillance system.

Upon command, the conditions at the input are memorised in a register. Thereafter, if any condition changes it is immediately noticed by a comparator and the fact is entered in a 'change' register. At the same time a LAM is produced to call the attention of the computer. The LAM is reset when the content of the change register is read out and the new conditions at the input are stored in a latch to ensure that no alarm is accidently lost.

The first 8 of the 24 bits can be selectively associated with a LAM-Mask to inhibit the production of an alarm from specific channels when necessary. Additionally, the whole module can be inhibited from producing a LAM.

Delivery: Autumn 1971




***Ref. Borer & Co.***

---

## Universal Input/Output Register

Input/Output Register Type 1031 permits external measuring instruments such as Analogue to Digital Converters, Counters and similar digital output devices to give data to a CAMAC system and to be controlled by the system.

The 36-bit input is divided into two parts normally consisting of 24 bits intended for the intake of data and a further 12 bits for the intake of range information. In practice, however, the ratio of the number of data to range bits can be varied to suit the need by arranging the external connections accordingly.

The 12-bit output is subdivided into three blocks of 4 bits which can be loaded either separately or simultaneously from the dataway. The output can be used for a variety of purposes such as range changing in external instrumentation, lamp displays and indications as well as decimal displays (three BCD numerals).

# NEW PRODUCTS

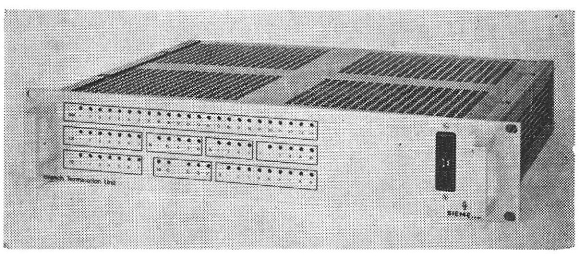
## SYSTEM UNITS, TEST EQUIPMENT

### Branch Termination

The branch highway interconnects the CAMAC crates and the computer interface; the transmission rate may be very high. To avoid interference by signal reflection the branch termination must be matched. Furthermore, the termination resistance has to feed in the pull-up current if the transmitters of the crate controller are open collector gates. And finally, for test and service, it is often necessary to display the signals of the Branch Highway. The Branch Termination Unit fulfils these requirements.

The unit is contained in a 19″ chassis, 2U high and has a self-contained power supply. The branch signals are stored for display on initiation by timing signal BTA. Display: 66 lamps.

Advantages:
- trouble-free service;
- clear and simple checking;
- easy reading of the dynamic state of branch highway signals.



***Ref. Siemens AG***

### Branch Highway Test Point Module (CD 18104)

This unit is designed to give a total of twenty-four access points to the branch highway. Each access point is fitted with a suitable P.T.F.E. insulated terminal that will accept spring loaded types of probe that are available with most commonly used oscilloscopes. Two spare access points are provided for cross connection with circuits not connected to the 22 points designated as follows:

| | | |
|---|---|---|
| BTB 1 | BN 1 | BCR 1 |
| BTB 2 | BN 2 | BCR 2 |
| BTB 3 | BN 4 | BCR 3 |
| BTB 4 | BN 8 | BCR 4 |
| BTB 5 | BN 16 | BCR 5 |
| BTB 6 | | BCR 6 |
| BTB 7 | | BCR 7 |
| BTA | BG | BD |

*Physical Layout:*

One Branch Highway connector (male) on a common glass-reinforced epoxy shell.
Overall dimensions: 7.11 cm long, 5.72 cm high and 2.86 cm wide.

***Ref. EMIHUS Ltd.***

### Remove Inhibit Module (CD 18105)

The unit has been designed to enable the 'Inhibit' condition on the Branch Highway to be removed by means of a simple push-button. (Single-pole, change-over type.)

The module is plugged into one of the WSS 0132 Socket mouldings on the Crate Controller type 'A' and connection to the +ve rail is made via a flying lead 24 inches (60.96 cm) long and a subminiature plug of the Harwin type.

Connection to the earth rail is made to Pin No. 1 of circuit BA 1. For crate controllers manufactured after October 1971 provision has been made within the module for earth connection to BX 9 (Pins 111 and 75).

The 'Remove Inhibit' push-button removes the condition from the following circuits:

| | | |
|---|---|---|
| BCR 1 | BCR 6 | BN 16 |
| BCR 2 | BCR 7 | BN 8 |
| BCR 3 | BA 1 | BN 4 |
| BCR 4 | BA 8 | BN 2 |
| BCR 5 | BF 8 | BTA |
| | BF 16 | |

*Physical Layout:*

Common glass-reinforced epoxy shell.
Overall dimensions: 7.11 cm long, 5.72 cm high and 2.86 cm wide.

***Ref. EMIHUS Ltd.***

## I/O REGISTERS DISPLAYS

### Clock/Timer (Type 1411)

The Clock/Timer Type 1411 is a dual-purpose single-width CAMAC unit which provides both the true time for incorporation in print-outs, displays, etc. from data logging, surveillance and control systems, as well as acting as a presettable timer.

BCD coded time signals are available via the dataway with a resolution to the nearest ms and at a connector on the front panel to display hours (up to 24), minutes and seconds externally. When necessary, the time can be adjusted (hours and minutes) from the dataway.

The output of a built-in quartz-controlled oscillator, accurate to $1.10^{-4}$, is normally used as a time base but can, upon request, be replaced by the mains frequency. In the latter case the resolution is 10 ms. A synchronisation input is provided so that minute pulses from a master-clock can be introduced to correct for long-term drift effects in the oscillator.

For use as a timer, the module contains a count-down counter and a register which can be loaded from the dataway. Upon command, the content of the register is loaded into the counter which then counts, (pulses of 1 ms, 10 ms, ... 100 ms according to choice) down to zero when a LAM is generated. Two operational modes are possible: 'Automatic recycling' and 'On-command'. In the first case, the counter is immediately reloaded from the register on reaching zero and begins a new timed period auto-

# MEMBERSHIP OF THE ESONE COMMITTEE

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

| | | | |
|---|---|---|---|
| **International** | European Organization for Nuclear Research (CERN) | *F. Iselin** | Geneva, Switzerland |
| | Centro Comune di Ricerca (Euratom) | *L. Stanchi* | Ispra, Italia |
| | ESONE Secretariat | *W. Becker** | |
| | Bureau Central de Mesures Nucléaires (Euratom) | *H. Meyer** | Geel, Belgique |
| **Austria** | Studiengesellschaft für Atomenergie | *R. Patzelt* | Wien |
| **Belgium** | Centre d'Etude de l'Energie Nucléaire | *L. Binard* | Mol |
| **Denmark** | Forsögsanläg Risö | *Per Skaarup* | Roskilde |
| **England** | Atomic Energy Research Establishment | *H. Bisby** | Harwell |
| | Culham Laboratory | *A.J. Vickers* | Abingdon |
| | Daresbury Nuclear Physics Laboratory | *B. Zacharov* | Warrington |
| | Rutherford High Energy Laboratory | *M.J. Cawthraw* | Chilton |
| **France** | Centre d'Etudes Nucléaires de Saclay | *P. Gallice** | Gif-sur-Yvette |
| | Centre d'Etudes Nucléaires de Grenoble | *J. Lecomte* | Grenoble |
| | Institut Max von Laue - Paul Langevin | *A. Axmann* | Grenoble |
| | Laboratoire de l'Accélérateur Linéaire | *Ph. Briandet* | Orsay |
| **Germany** | Deutsche Studiengruppe für Nukleare Elektronik c/o Physikalisches Institut der Universität | *B.A. Brandt* | Marburg |
| | Deutsches Elektronen-Synchrotron | *D. Schmidt* | Hamburg |
| | Hahn-Meitner-Institut für Kernforschung | *H. Klessmann* | Berlin |
| | Kernforschungsanlage Jülich | *K.D. Müller** | Jülich |
| | Gesellschaft für Kernforschung | *K. Tradowsky* | Karlsruhe |
| | Institut für Kernphysik der Universität | *W. Kessel* | Frankfurt/Main |
| **Greece** | Demokritus' Nuclear Research Centre | *Ch. Mantakas* | Athens |
| **Hungary** | Central Research Institute for Physics | *J. Biri* | Budapest |
| **Italy** | Comitato Nazionale Energia Nucleare (CNEN) | *B. Rispoli** | Roma |
| | CNEN Laboratori Nazionali | *M. Coli* | Frascati |
| | CNEN Centro Studi Nucleari | *F. Fioroni* | Casaccia |
| | Centro Studi Nucleari Enrico Fermi | *P.F. Manfredi* | Milano |
| | Centro Informazioni Studi Esperienze | *P.F. Manfredi* | Milano |
| | Istituto di Fisica dell'Università | *G. Giannelli* | Bari |
| **Netherlands** | Reactor Centrum Nederland | *P.C. van den Berg* | Petten |
| | Instituut voor Kernphysisch Onderzoek | *E. Kwakkel* | Amsterdam |
| **Poland** | Instytut Badan Jadrowych | *R. Treckinski* | Swierk K/Otwocka |
| **Sweden** | Aktiebolaget Atomenergi Studsvik | *Per Gunnar Sjölin* | Nyköping |
| **Switzerland** | Institut für Angewandte Physik der Universität | — | Basel |
| **Yugoslavia** | Boris Kidrič Institute of Nuclear Sciences | *M. Vojinovic* | Vinča Belgrade |

**LIAISON WITH THE USAEC NIM COMMITTEE IS MAINTAINED THROUGH:**

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

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

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

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

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

# NEWS

## CAMAC ACTIVITIES AT NORTH AMERICAN LABORATORIES

### National Accelerator Laboraroty, USA

CAMAC is being used for control of the 8 GeV booster that feeds the 200 GeV main ring. In addition, CAMAC is to be used for instrumentation of experiments. Since this laboratory is a national high-energy facility, many groups from other organisations will be utilising this powerful accelerator. This places an extra premium on instrument compatibility. PDP-11 computers will be interfaced through standard CAMAC branch highways.

### Stanford Linear Accelerator Center, USA

Several CAMAC systems are currently in operation at the Stanford Linear Accelerator Center (SLAC). It is expected this spring that beam will be injected into the SLAC Electron Positron Storage Ring Facility (SPEAR) which will be utilised by many outside groups. For experiments using standard CAMAC systems, a Branch Highway interface complying with the EUR 4600 specification is under development for operation with the Sigma 5 computer.

### TRIUMF (TRI University Meson Facility), Canada

The TRIUMF accelerator, which is scheduled for operation in 1973, will provide simultaneous beams of protons, pions, muons, and neutrons. The proton energies will be continuously variable from 150 to 500 MeV; a beam current of 400 μA is expected at 450 MeV. The control instrumentation utilises CAMAC. Multicrate operation is via the standard branch highway of EUR 4600, though the highways are of the balanced-line type using single-ended-to-balanced converters together with Type A controllers.

### Los Alamos Scientific Laboratory, USA

An extensive evaluation of CAMAC has been concluded at the Los Alamos Meson Physics Facility (LAMPF) with highly satisfactory results. Consequently, CAMAC is to be used in experiments with the high intensity 800 MeV LAMPF proton Linac, and user groups are urged to do likewise for maximum compatibility with LAMPF instrumentation and maximum LAMPF instrumentation support.

One phase of the evaluation involved a comparison of system costs for a relatively complex experiment interface done in CAMAC is special purpose hardware. The CAMAC equipment costs no more than the other hardware and the engineering costs strongly favoured CAMAC. By using CAMAC hardware, the interface could have been designed, assembled and tested in a short period of time for one-third of the labour required for the custom interface. This analysis made one thing clear ... any single device can be interfaced to a computer more cheaply through special purpose hardware, than through CAMAC. But when the whole experiment is considered, the system costs rapidly and strongly swing in favour of CAMAC hardware. Increasing interest in CAMAC by American suppliers and broader product lines will further enhance this margin.

A second phase of the evaluation involved an on-line application of CAMAC hardware. A special-purpose interface for a Compton-proton experiment was recently replaced by one assembled from commercial CAMAC equipment. The design called for a CAMAC crate and power supply, 32 scalers (24-bit, 100 MHz), 2 A/D converters (8-bit), input registers, interrupt registers, level converters, display driver, manual controller, and a Nova controller with cable and terminator.

The equipment order was split among two American and two European manufacturers. Delivery was prompt from three of the suppliers but unduly long from one of the European vendors. However, this situation is improving. The most important point is that the system worked when it was assembled, indicating that all of the suppliers adhered to the CAMAC standard. The weakest feature of the system was the power supply and this should be alleviated when supplies built to a new, standard specification are available.

A second CAMAC crate, Type A controller, and power supply were purchased and interfaced to the Nova computer using the branch highway approach. This development, while successful, showed the need for a sophisticated branch driver. Consequently, work is in progress in conjunction with Rice University and Florida State University to design a micro-programmed branch driver for use as a LAMPF standard.

Since CAMAC has been adopted as the LAMPF standard for interfacing experimental equipment to computers, users who plan to rely on LAMPF for maintenance support and spare parts should design their experiment interface around the CAMAC standards (EUR 4100e and EUR 4600e).

CAMAC is also to be used for the control of the secondary beam lines.

## NIM-CAMAC WORKING Groups
## Dataway Working Group

*Chairman: F. Kirsten, Lawrence Berkeley Laboratory*

The principal concern of the NIM-CAMAC Dataway Working Group in recent months has been the revision of the Dataway specification. During this time, close liaison has been maintained with the ESONE Dataway Working Group, both by mail and in person. NIM representatives have attended nearly all ESONE meetings, and ESONE representatives have been present at most meetings of the NIM Committee and NIM-CAMAC working group meetings. Because of this continuous communication, excellent agreement has been reached regarding the technical details involved in the updating of the CAMAC specifications.

Recently, the DWG has begun to look into alternative signal transmission standards for the Branch Highway. One objective is to determine whether the long distance and noise immunity properties of the branch can be enhanced, while maintaining maximum compatibility with existing equipment. Two approaches are being studied. In addition, a serial data transmission mode is being examined. This may be useful where a lower data rate can be tolerated.

### Mechanical & Power Supply Working Group

*Chairman: D.A. Mack,*
*Lawrence Berkeley Laboratory*

The working group has worked closely with the ESONE Mechanics Working Group in resolving dimensional matters concerning primarily the crate and the dataway connectors. The principal objectives have been to provide clarification, eliminate ambiguities and permit as much design freedom as is feasible without sacrificing compatibility and interchangeability. There is substantial agreement on the revisions to be made to EUR 4100 and it is clearly recognized that continued compatibility is a paramount consideration in all modifications contemplated.

The revised version of EUR 4100 will permit chamfers of between zero and one mm at the top and bottom of the printed dataway connector on the module. The working group and the NIM Committee prefer a chamfer of *zero* which is consistent with the specification requirements.

Two connectors are recommended for rear (or front) panel mounting on modules. These are the 52- and 19-pin versions of the Cannon 2D Subminiature connectors. The 2DB52P connector may be mounted on modules to attach to a 2DB52S cable connector; likewise the 2DE19P module connector attaches to a 2DE19S cable connector.

Specifications for a Typical CAMAC Power Supply providing plus and minus 6 volts and plus and minus 24 volts have been written after consulting with numerous users and manufacturers. The output current capability of the 6 volt supplies is 25 amperes each on a current sharing basis, such that the total combined current at plus 6 volts and minus 6 volts may be limited to 25 amperes. Likewise, the 24 volt supplies are current shared for a total combined output of 6 amperes with each of the supplies capable of providing 6 amperes. A standard power supply/crate interface connector (AMP 200512-3 mating with AMP 201359-3) is specified. While not applicable to every situation, the Typical Power Supply Specifications will provide a guide for power supply designers.

### Software Working Group

*Chairman: S. Dhawan, Yale University*

The Software Working Group is concentrating its work in three areas, namely language, I/0 processors and subroutines. The ESONE CAMAC preliminary language paper is under discussion and at the November meeting of the SWG alternate methods for system description were proposed. The group is examining the design of CAMAC I/0 processors from the software viewpoint and is exploring subroutine packages for use with CAMAC systems.

### Analog Signals Working Group

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

It was agreed at the ESONE meeting at Saclay in October 1971 that EUR 5100 ('Specification of Amplitude Analogue signals') will clearly state that the specifications therein 'do not apply to very fast signals where such specifications would degrade the performance.' This leaves a gap that it is desirable to fill. Therefore, the working group is developing standards for wide-band analog signals. It is recognized that the definition of 'wide-band' constitutes a problem in itself and that a 'grey area' exists in which signals can be considered as wideband or non-wide band. Consideration is being given to specifying that the 'wide-band' standards be mandatory for signals with rise-times less that a certain value (say 15 $\eta$sec) and optional for signals with rise times between that value and a somewhat larger value (say 50 $\eta$sec). However, this matter is still being studied and the proposal may be modified to some extent prior to or during discussions with the working ESONE Group.

# NEWS

## ANNOUNCEMENTS BY CAMAC NANUFACTURERS

**NUCLEAR ENTERPRISES LIMITED (U.K.)** has purchased the interests of EKCO Instruments Limited in the fields of CAMAC computer-interface equipment, industrial applications of nucleonic instruments and in nuclear geophysical instrumentation. The transfer of activities will be effective from 1st January, 1972. A number of key EKCO personnel have joined Nuclear Enterprises to ensure a smooth change-over continuance of products and maintenance of good customer relations.

# 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: Mr. H. Klessmann, HMI, Berlin*

This working group has the responsibility for both basic CAMAC documents on digital data communication within the CAMAC system, EUR 4100 and EUR 4600. A close and very constructive collaboration with the US AEC NIM Committee (Chairman Mr. L. Costrell, National Bureau of Standards, Washington) and the corresponding US CAMAC Dataway Working Group (Chairman Mr. F. Kirsten, Lawrence Berkeley Laboratory, California) has achieved that identical standards of CAMAC systems are accepted in Europe and the United States.

The 'Specification of the Branch Highway and CAMAC Crate Controller Type A' (already well-known to the outside world as the preliminary issue of November, 1970) was presented to the ESONE General Assemby as 'Proof Copy, October 1971' at Saclay, with some amendments. With minor modifications the *final* text of this document was accepted by the ESONE General Assembly for publication as EUR 4600 e. This final document will be available soon, as printing started in January, 1972. This 'Branch Highway' document has also been adopted by the AEC-NIM Committee at a meeting in San Francisco, November 1971, and will be published in the United States under an AEC-NIM report number, with identical text and reference to the ESONE report.

An interim report on the revision of the 'Dataway' document EUR 4100 e has been approved also by the ESONE General Assembly 1971. Since then further progress has been achieved with considerable and constructive assistance from the NIM CAMAC Dataway Working Group. The major concern of this revision is:

— to make the CAMAC system (and the specifications) better understood.
— to improve the performance of the system.
— and to maintain compatibility with the present designs for the benefit of the industry and the users.

It is expected that agreement on the final text of the revised document will be reached at a Dataway Working Group Meeting to be held at the beginning of Febru ary 1972. The revised document will be published by the ESONE Committee as EUR 4100 e (1972), and in the United States by the AEC NIM Committee under a different report number but again with identical text and reference to the ESONE document.

### Mechanics Working Group

*Chairman: F. H. Hale, AERE Harwell, England*

This working group is responsible for the mechanical constructional standards of CAMAC crates and plug-in units. Following previously reported meetings at CEN, Saclay and AERE, Harwell, the Working Group met at Saclay in October and presented to the ESONE Committee General Assembly recommendations to improve the definition and presentation of the mechanical standards. Many dimensional tolerances have been increased where this can be achieved while maintaining compatibility with existing equipment.

The Working Group is currently engaged in revising the diagrams and text for publication in the revised version of EUR 4100.

### Software Working Group

*Chairman: I. Hooton, AERE Harwell, England*

The group is proceeding with the revision of the CAMAC Language Paper presented to the General Assembly. It is hoped that this will be ready for publication in the near future.

Attention is now being directed more specifically at the Intermediate Language. This has three possible applications:

i) It may serve as the machine independent output from a translator of the CAMAC Language.
ii) It may serve as an Assembly Level Language for direct application to simpler systems.
iii) It may also help in the specification of Controller functions.

Final comments have been made on the software implications of the revision to EUR 4100e.

### Information Working Group

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

This Working Group was set up in October 1970 to disseminate information on CAMAC and CAMAC activities, to provide an improved dialogue between users and suppliers of CAMAC facilities and to encourage the wider application of CAMAC.

This Group has launched the CAMAC Bulletin. Issue No. 1 was distributed in June and Issue No. 2 in November 1971. This Bulletin is distributed practically all over the world and the mailing list actually consists of more than 3,000 individual addresses. The contents of the Bulletin is being developed according to suggestions from readers and will include more information on software and special feature articles discussing some particular aspect of the CAMAC compatibility rules.

Recent discussions indicate that continued and increasing support in publishing future Issues of the Bulletin will be provided by the Commission of the European Communities. The Working Group gratefully acknowledges this support and also that already received.

## BRANCH HIGHWAY DRIVERS

The TTL power drivers SN49 700N and SN49 701N have TTL inputs and high fan-out open-collector outputs. They are very versatile as they have, for example, an extra input for joining a Miller-capacitor for generating slow rise- and fall-times (c.f. BTA, BTB, BD signals). However, their delay times are not specified. In one batch, delay times of about 400nsec for 100% of the components have been measured.

Using transistors (e.g., 6 transistors in one DIP, like SGS U.14 985/1 or SGS EY 23014) needs extra space for drivers which can generate the necessary base current.

The TTL dual peripheral driver SN75 450N is very similar to the SN49 700N, but has the advantage of specified (typical) delay times and transition times. It is possible to add a Miller-capacitor.

Another very good solution (but without the possibility of joining a Miller-capacitor) is the SN75 451P. This TTL dual-driver is built into an 8-pin dual in-line package. It has very small delay and transition times (typically 12 and 8nsec respectively).

REFERENCES

1. EURATOM EUR 4600 e, preprint. CAMAC-Organisation of Multi-Crate Systems. Specification of the Branch Highway and CAMAC Crate Controller Type A.
2. EURATOM EUR 4100 e. CAMAC—A Modular Instrumentation System for Data-Handling. Description and Specification, March 1969.

---

## PREPARATION of PAPERS for the CAMAC BULLETIN

*Contributors of papers for the APPLICATION NOTES, LABORATORY ACTIVITIES and COMPANY ACTIVITIES Sections of the Bulletin are asked to follow these instructions.*

1. *Manuscripts should be typed on alternate lines, on one side of the sheet.*
2. *Papers should be about 1200-1600 words, with a maximum of 2000 words, or 3 pages including illustrations.*
3. *The preferred language is English; papers in other languages will be published without translation.*
4. *Follow as closely as possible the style used in this issue of the Bulletin for the title of the paper, name of the author, his business affiliation, city and state, layout of headings, and the use of bibliographic references.*
5. *Drawings: supply original ink (not pencil) drawings.*
6. *Photographs: supply semi-mat prints at least twice the final size.*
7. *Write the author's name and the Figure number lightly in pencil on the back of each illustration.*
8. *List all captions with Figure numbers on a separate sheet, even if they are given in the text or on the illustrations.*

---

# NEWS

## ANNOUNCEMENTS BY CAMAC MANUFACTURERS

**EMIHUS MICROCOMPONENTS LTD.** (U.K.) has announced the development of a series of units which can be used with the standard branch highway connector. Two units are now available, a Branch Highway Test Point Unit (CD 18014) and a Remove Inhibit Unit (CD 18105). Other units undergoing development are a Cable Extension Unit (CD 18106) in a robust metal box and a Branch Highway Termination Module (CD 18107) similar in dimensions to CD 18014 and CD 18105.

**AEG TELEFUNKEN** (Germany) demonstrated a CAMAC interface for their multi-channel analysers at the ESONE General Assembly (Oct. 1971). The block transfer of channel contents onto the Dataway uses the Parallel Input Register (MSPI 1 1230). Computer control via the Dataway is effected by the Parallel Output Register (MSPO 1 1230). The MSPI 1 1230 may also be used for direct transfer of data from the Company's 200 MHz ADC onto the Dataway.

**WENZEL ELEKTRONIK** (Germany) is preparing to supply a crate system controller for PDP-11, a clock generator, a 24-bit preset scaler, a 4 × 16-bit scaler and a B-to-BCD converter.

chosen (see Table 1) permits the direct generation

GL-Operation

**ANALOGUE OUTPUT SIGNALS**

Current 0 to $+5\,mA$ (voltage limited to $\pm 10\,V$).

Noise suppression 80 dB (0-1 kHz).
$\geq 60$ dB (1 kHz-1 MHz).

Conductance of the current source: $<0,\ 1\,\mu.mho$.

Cut-off frequency $\sim 1$ kHz.

Temperature Coefficient of current $\sim 10$ p.p.m./°C
Temperature Coefficient of conductance $\sim 10^{-3}\,\mu.mho/°C$ } 20 to 45 °C

**DIGITAL OUTPUT SIGNALS**

$2 \times 12$-bits, open-collector. Pull-up resistor to max. $+15\,V$ in the external device. Negative logic.

**REFERENCES**


1. AEG Telefunken, CAMAC Bulletin No. 1, 21.
2. G. Rüschmann, R. Staudte, I.K.F. IB 35, October 1970.
3. Protokol der Schnittstellendiskussion 16.2.1971. Frankfurt/M.


# NEWS

## CAMAC IN THE BOWLING ALLEY

Kinetic Systems Corporation of Lockport, Illinois, USA, has taken CAMAC from the laboratory into the bowling alley. They have implemented a computer-controlled automatic scoring system in which one crate can serve up to six bowling lanes. The presence or absence of pins is sensed by an optical unit and the data is read via an input register. A 16-key keyboard also connected to the input register, is located at each of the four lanes currently implemented to allow the bowler to communicate with the system for making changes in the bowling order, skipping bowlers, entering corrections, etc. The scores are displayed on television screens utilizing display modules, one screen being used for each lane. The scores are presented in conventional bowling format for up to six bowlers per lane, with the exception that the display shows the actual pins left standing for each ball throughout the game rather than recording the number of pins knocked down. Strikes and spares are indicated in the conventional manner as is the frame-by-frame score.

## ANNOUNCEMENTS BY CAMAC MANUFACTURERS

**TEKDATA LTD.** (U.K.) is now manufacturing branch highway cables employing a new type of harness having multi-conductor cables with oval cross-sectional area. In comparison to conventional circular section cables, this new cable has a low profile, is more flexible, lighter in weight and fits perfectly into the hood of the branch highway connector.

**NUCLEAR ENTERPRISES LIMITED** (U.K.) has received a contract from Computer Technology Limited (C.T.L.) England, for the development of a CAMAC System Controller to act as the CAMAC link for a CTL 'Modular One' computer.

When available, early in 1972, the combination of the Controller and the 'Modular One' computer will provide the basis for a wide range of competitively priced data-handling systems, and will also stimulate the rapidly growing interest in CAMAC-based data-handling systems.

CAMAC systems may also be remotely situated from the 'Modular One' computer and connected to it via a communications line. For example, C.T.L. are developing a system based on N.E. CAMAC modules for data-acquisition systems in pathology laboratories. The resultant system is tailored easily to individual laboratories, can be expanded readily and can serve a number of laboratories at any distance from the computer.

**RODCOR INDUSTRIES INC.** (USA) is manufacturing the power supply unit specified by LRL Berkeley for use with CAMAC crates.

*Specifications*

Input:

117±12% VAC 60 ±3HZ (50HZ available on request)

Outputs:

± 6VDC 25A Outputs Shared to 150W
±24VDC 6A Outputs Shared to 150W

Optional:

*a*) ±12V 3A Derived and current shared with ±24V
*b*) +200V 0.1A Unregulated. 2V Ripple

Regulation:

6V — ±0.5% for 24hrs. over line and load
12V — ±0.3% for 24hrs. over line and load
24V — ±0.2% for 24hrs. over line and load

Noise & Ripple:

less than 15mv peak to peak

Transient Response:

less than 100 micro-sec for 50% load change.

Temperature Range:

0 to 50°C without derating.

Voltage Adjustment:

±5% minimum

Protection:

*a*) Foldback Current Limiting
*b*) Crowbar at +20% max., +15% min.

Air Supply:

4 fans @ 43CFM each

Metering:

Voltage and current, all outputs except 200V

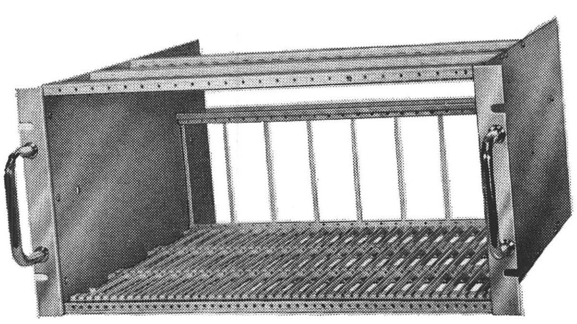
Blower Section:

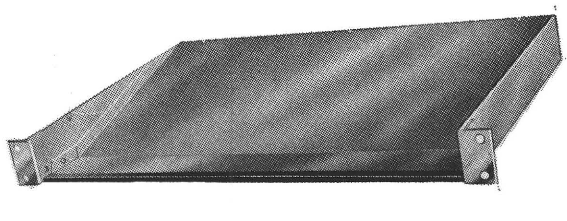
With meters and switches

***Ref. RODCOR Industries Inc.***

### Separate Ventilation Drawer for CAMAC Crates

An on-site choice of ventilated or plain crates is offered by the introduction of a separate ventilation





drawer. This allows CAMAC users to have a greater flexibility without excess stocks of empty crates.

When the drawer is added it converts a plain 5U Crate to a ventilated 6U version. Since there is no physical connection between the drawer and the crate, the drawer may be added to existing crates on which natural ventilation has been found inadequate.

***Ref. Willsher & Quick Ltd.***

## COMPONENTS

### CAMAC Dataway and Power Rail by Film Wire Packaging

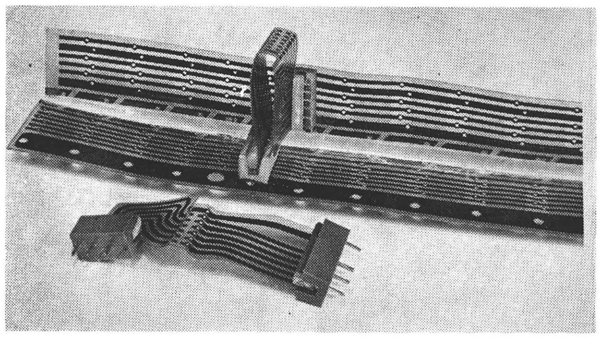
The Crate wiring, power rails and Dataway require a fairly high standard of mechanical and electrical uniformity which is dependent on the human element during the Wiring operation.

The existing method wiring a conventional power rail assembly and dataway is by a multi-layer plate-through hole printed board, the cost of which, including testing, is very high. Wire-wrapping is a more reliable method, but this still has the disadvantages of human error coupled with being time consuming.

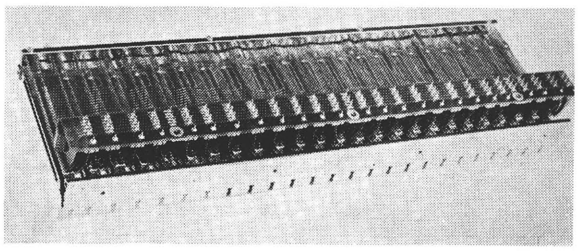
M.B. Metals considered that a system more in keeping with advanced technology of the 'CAMAC' concept could be achieved by Film-Wire Packaging Techniques, which would embody reliability, repeatability, control of characteristics, saving in production and testing costs, coupled with ability to extend the system to its full capacity with the minimum additional circuitry.

The Film-Wire System is divided into two basic assemblies:

(1) *Power Rail Assembly* — comprises a Film-Wire Circuit with bus bars printed in oxygen-free rolled-copper tracks on a Kapton HF Substrate and cover-coated in Kapton HF. Provision is made via solder pads for up to 25 stations. Three areas of the



*Method of Assembly Power Rail*



*Power Rail and Dataway Assembly.*

bus bar circuit have been re-inforced and power supplies are fed into these areas via pins for all circuits with the exception of the 'O' Volts line. Termination to this is made by bolting down Indium plated cable ends onto three large termination pads which are also Indium plated.

Connections between the power rail and the 7+7 pins allocated on the edge connector sockets are made by a film-wire link circuit comprising the film-wire circuit and two M.B. Metals' minature 'M' blocks.

(2) *Dataway assembly* comprises four film-wire layers or formats. These are assembled in numerical order onto the mini wrap pins of the edge connector socket; space between layers is not critical with the exception of layers 1 & 2, where the space should not be less than 4.7625mm to ensure minimum cross-talk.

*Materials*

The materials used for all the back wiring circuits have been selected to ensure that the highest electrical and mechanical standards are achieved, even under mass production assembly techniques, and any single unit can be replaced individually.

The M.B. Metals CAMAC back wiring assembly will ensure that a high degree of repeatability in assembly and electrical characteristics is maintained at reduced production costs.

***Ref. MB Metals Ltd.***

---

## PREPARATION OF NEW PRODUCTS CONTRIBUTIONS

*Please follow as closely as possible the style used in this issue of the Bulletin, and the relevant instructions given elsewhere for contributed papers, with the exceptions:*

1. *Please type each product description on a separate page.*
2. *The description of a single product should not exceed 250 words, or one third-page including illustrations.*
3. *Photographs and drawings may be used, if they are essential to illustrate the product and are suitable for reduction to fit the available space.*
4. *Unless translations are specifically requested, the contributions will be printed as submitted, apart from minor corrections (e.g., spelling, punctuation and layout).*

---

# NEWS

## Manufacturer's Index to "News" and "New Products" Information

# 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 14th December, 1971.

The number of items of commercially available CAMAC equipment is still increasing rapidly, the current list containing some 30 percent more items than in Issue 2 of the Bulletin. Every effort has been made to ensure the completeness and accuracy of the list, and it is hoped that most products and manufacturers have been included. Inclusion in this list does not necessarily indicate that products are fully compatible with the CAMAC specifications nor that they are recommended or approved by the ESONE Committee. Similarly, omission from this list does not indicate disapproval by the ESONE Committee. Users are advised to obtain detailed information from the manufacturers or their agents in order to check the compatibility and operational characteristics of equipment.

Some changes have been introduced in the listing for this Issue as a result of comments made on the lists contained in the previous Issues. The signs indicating special external interconnections and front-panel connections have been removed, the explanatory comment in brackets following the manufacturers designation contains instead this indication.

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

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

Remarks on some columns in the Index of products:

N/C – N is new, C is corrected entry;

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

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

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

## CLASSIFICATION GROUPS

# INDEX OF PRODUCTS

| N/C | DESIGNATION+SHORT DATA | TYPE | MANUFAC-TURER | WIDTH | DELIV. | NPR |
|---|---|---|---|---|---|---|
| | **BRANCH HIGHWAY RELATED SYSTEM UNITS** (Computer Couplers, Crate Controllers, Terminations) | | | | | |
| C | Interface for HP 2114B/2115B/2116B (Progr. sequent and block transfers) | 2201 | Borer | NA | /71 | |
| N | Interface for DEC PDP-9 Computer (Progr. sequent and block transfers) | 2202 | Borer | NA | /71 | |
| N | Interface for DEC PDP-15 Computer (Progr. sequent and block transfers) | 2203 | Borer | NA | /71 | |
| N | Interface for VARIAN 6201/L/F Computer (Progr. sequent and block transfers) | 2204 | Borer | NA | /71 | |
| | PDP-11 CAMAC Controller (Sequential read/write, 24 Graded-L interrupt directly) | CA 11-A | DEC | NA | 05/71 | (2) |
| | PDP-15 CAMAC Interface (18/24 bit, progr. sequent addr and block transfer modes) | CA 15 A | DEC | NA | 05/71 | (1) |
| | PDP-9 CAMAC Interface (Somewhat modified CA 15 A) | CA 15 A/PDP-9 | DEC | NA | 07/71 | |
| C | PDP-11 Branch Driver (EUR 4600 compatible, programmed and sequent addr modes) | BD-011 | EG+G | NA | /71 | |
| | PDP-11 Interface System comprising | SI-11 | GEC-Elliott | | /71 | |
| | Executive Controller | MX-CTR-1 | | 2 | | |
| | Branch Coupler | BR-CPR-1 | | 2 | | |
| C | Programmed Transfer Interface (can drive Dataway alone) | PTI-11 CD | | 2 | | |
| | Unibus Termination Unit | TRM-11 | | 1 | | |
| | Interrupt Vector Generator | IVG-11 | | 1 | | |
| | Display Driver (controls 72A display, also crate CTR and branch driver) | 72A | Jorway | 3 | 07/71 | |
| N | Branch Driver | 7081 | Nucl. Enterprises | 0 | /71 | |
| N | PDP 11 Interface and Branch Driver System | | Nucl. Enterprises | 0 | | |
| N | Interface CAMAC-PDP 11 (Programmed, block transfer and sequential addr modes) | ICP 11 | SAIP-CRC | NA | /71 | |
| N | Nova Computer to CAMAC Master Branch highway driver (one to three branches) | MC-2010 | Techcal | 0 | 11/71 | |
| N | Slave Branch Highway Driver | MC-2016 | | 0 | 11/71 | |
| | Crate Controller /ESONE Type A/ (conforms to EUR 4600 specs) | 1501 | Borer | 2 | 01/71 | |
| C | ESONE Type A Crate Controller (conforms to EUR 4600 specs) | CC 2404-1 | GEC-Elliott | 2 | 01/71 | |
| N | Contrôleur de châssis multi 8-CAMAC (24 bit, progr. simult I/O, interrupt modes) | JCM 8 | Intertechnique | 3 | 09/71 | |
| | Branch Crate Controller/Type A (conforms to EUR 4600 specs) | 70 | Jorway | 2 | 01/71 | |
| | Crate Controller Type A (conforms to EUR 4600 specs) | C 106 | RDT | 2 | 06/71 | |
| | Contrôleur de Châssis Type A (conforms to EUR 4600 specs) | J CRC 50 | SAIP-CRC | 2 | 02/71 | (1) |
| | *A* Crate Controller (conforms to EUR 4600 specs) | ACC 2034 | SEN | 2 | 06/71 | |
| C | CAMAC Crate Controller Type A (conforms to EUR 4600 specs) | CC 100L | EG+G | 2 | /71 | |
| N | Branch Termination Unit | | Siemens | 0 | | (3) |
| | Crate Controller A (conforms to EUR 4600 specs) | C72451-A1446-B1 | Siemens | 2 | 10/70 | (1) |
| C | Termination Unit | 1591 | Borer | 2 | /71 | |
| C | Terminator Module (Branch Highway terminator) | TC024 | EG+G | 2 | /71 | |
| N | Branch Highway Termination Module (mounts directly on Branch Highway assembly) | CD 18107 | Emihus | NA | /72 | |
| | Branch Termination Unit | BT 6601 | GEC-Elliott | 2 | 01/71 | |
| | Branch Termination | 50 | Jorway | 2 | 01/71 | |
| N | Terminaison de Branche CAMAC | J BT 20 | SAIP-CRC | 2 | 11/71 | |
| N | Crate Controller Bus Terminator for *A* Crate Controller ACC 2034 | BT 2042 | SEN | 0 | 11/71 | |

| N/C | DESIGNATION+SHORT DATA | TYPE | MANUFAC-TURER | WIDTH | DELIV. | NPR |
|---|---|---|---|---|---|---|
| | **DATAWAY RELATED SYSTEM UNITS** (Computer Couplers, Controllers) | | | | | |
| N | Crate Controller Type D (Conforms to EUR 4100, used with do 280 Computer System) | DO-280-2901 | Dornier | 2 | 11/71 | |
| | Crate Controller for Nova Computer | CC 2023A/B | SEN | 2 | /70 | |
| C | Crate Controller Bus Terminator for CC 2023A/B (one per system) | BT 2022 | | 0 | 11/71 | |
| | Dataway Controller DDP-516 (part of 7000-ser system with ext control highway) | 7022-1 | Nucl. Enterprises | 4 | /70 | |
| | Dataway Controller PDP-8 (part of 7000-ser system with ext control highway) | 7048-2 | Nucl. Enterprises | 2 | /70 | |
| | Auxiliary Controller PDP8 | 7049-1 | | 3 | /71 | |
| | Auxiliary Controller | 7047-1 | | 1 | /70 | |
| | Computer Interface | | Interdata | 0 | 07/71 | |
| | **OTHER SYSTEM UNITS** | | | | | |
| C | Start-Stop Controller (start, stop and reset outputs, manual or Dataway control) | FHC 1304A | BF Vertrieb | 1 | 01/71 | (1) |
| | LAM Grader (CERN specs 064) | C 107 | RDT | 1 | 06/71 | |
| | Commande "Arrêt-Marche" (start-stop unit start, stop, clock, and gate outputs) | J AM 10 | SAIP-CRC | 1 | 01/71 | |
| | Four Fold Busy Done (start signal initiated by command, device returns LAM) | 4BD 2021 | SEN | 1 | 02/71 | |
| | Overflow-Inhibit-Driver | C72451-A1454-A1 | Siemens | 0 | 01/71 | |
| | Overflow-Driver | C72451-A1452-A1 | Siemens | 0 | 10/70 | |
| | Store | N600 | Texas Instr. Ltd | 0 | 07/71 | |
| | Programmed Dataway Controller (part of 7000-ser system with ext contr highway) | 7025-2 | Nucl. Enterprises | 2 | /70 | |
| | Auxiliary Controller | 7080-1 | | 0 | /71 | (2) |
| | Sequential Command Generator | 7037-1 | | 2 | /70 | |
| | Command Generator | 7062-1 | | 2 | /71 | |
| | Transfer Register | 7063-1 | | 1 | /70 | |
| | Program Control Unit | 0362-2 | | NA | /70 | |
| | Plugboard Store | 0361-2 | | NA | /70 | |
| | Wired Store | 7044-1 | | 1 | /70 | |
| | Store Interface | 7067-1 | | 0 | /71 | (2) |
| | Plugboard Store | 7077-1 | | 3 | /71 | |
| | Multicrate System with External Control Highway, Comprising | 7000-series | Nucl. Enterprises | | /70 | |
| | Local Intercrate Interface | 7033-1 | | 2 | | |
| | Local Slave Dataway Controller | 7034-1 | | 2 | | |
| | Remote Intercrate Interface | 7035-1 | | 2 | | |
| | Remote Sub-Master Dataway Controller | 7036-1 | | 2 | | |
| N | Digital Control Module (bidirectional control via R/W-lines of four 4 bit devices) | TC-0440 | Techcal | 2 | 11/71 | |
| N | Digital Control Module (bidirectional control via R/W-lines of four 8 bit devices) | TC-0840 | Techcal | 2 | 11/71 | |
| | **MANUAL CONTROLLERS AND TEST EQUIPMENT** | | | | | |
| | Manual Dataway Controller | 7024-1 | Nucl. Enterprises | 8 | /70 | |
| | Manual Dataway Controller | C 108 | RDT | 8 | 06/71 | |
| C | Contrôleur Manuel de Châssis (manual test module) | J CMC 10 | SAIP-CRC | 8 | 06/71 | (1) |
| N | Dispositif de Contrôle Manuel de Dataway (manual controller/display system) | D AI 10 | SAIP-CRC | 1 | 11/71 | |
| N | Tiroir de Prise d'Information (interface to Dataway) | J DA 10 | | 1 | 11/71 | |
| N | Châssis de Contrôle et Affichage (control and display chassis) | C AI 10 | | NA | 11/71 | |
| C | Châssis de Contrôle Manuel de Branche (compr types CCOB10/TCMB10/TIC10/TIC20) | C CMB 10 | SAIP-CRC | NA | 09/71 | (1) |
| C | CAMAC Dataway Display (Dataway signal pattern stored/displayed, 2 test modes) | 1801 | Borer | 1 | /71 | (1) |
| | Test Module (Hardware and software test unit for BD-011) | TMO24 | EG+G | 2 | /71 | |
| N | Manual Crate Controller | GFK-LEM | Eisenmann | 8 | 11/71 | |
| N | Branch Highway Test Point Module (24 direct, 22 indirect access points for test) | CD 18104 | Emihus | NA | 10/71 | (3) |

| N/C | DESIGNATION+SHORT DATA | TYPE | MANUFACTURER | WIDTH | DELIV. | NPR |
|---|---|---|---|---|---|---|
| N | Branch Highway Remove Inhibit Module (removes Inhibit from BCR/BA/BF/BN/BTA) | CD 18105 | Emihus | NA | 10/71 | (3) |
| C | Dataway Test Module (Neon indication of state of all Dataway logic lines) | DIM 1 | GEC-Elliott | 2 | 01/71 | |
| N | Crate Controller Tester | NU 969 | GEC-Elliott | 0 | 10/71 | |
| | Dynamic Test Controller (Generates all possible CAMAC commands in single crate) | TC 2402 | GEC-Elliott | 4 | 01/71 | |
| N | Dataway Display (indicates logic state of Dataway lines) | 9019 | Nucl. Enterprises | NA | /71 | (1) |
| C | Dataway Buffer (outputs to 9019 Dataway signals accessible in normal station) | 9018 | | 1 | /71 | (1) |
| N | Test Module for Crate Controller CC 2023A/B | TM 2040 | SEN | 0 | /72 | |
| **SERIAL INPUT MODULES** (Scalers) | | | | | | |
| | Counting register (1×24 bit, 15 MHz, TTL/NIM signals, ext Inhibit in, Carry out) | 7070-1 | Nucl. Enterprises | 1 | /70 | |
| | Echelle Binaire 24 bits (Scaler, 20 MHz NIM or 10 MHz TTL I/P, ext Inhibit in, OVF O/P) | J EB 10 | SAIP-CRC | 1 | 01/71 | |
| | 25 MHz-Zaehler (1×24 bit, optional 16 bit, separate gate and Inhibit, man reset, NIM) | C72451-A1330-A1 | Siemens | 1 | 10/70 | |
| | Counter 250 MHz | C72451-A1448-A1 | Siemens | 0 | 10/70 | |
| | Miniscaler (2×16 bit, 30 MHz, separate gates and external Reset, NIM levels) | 1002 | Borer | 1 | 11/69 | |
| | Miniscaler (2×16 bit, 30 MHz, separate gates and external Reset, NIM levels) | C 104 | RDT | 1 | 06/71 | |
| | Dual 150 MHz 16 bit scaler (one 50 ohms, one unterminated NIM input per scaler) | 2S 2024/16 | SEN | 1 | /70 | |
| C | Dual 100 MHz Scaler (2×24 bin bits or 2×6 BCD digits, discr level −0.5V) | 80A | Jorway | 1 | 10/70 | (1) |
| | Dual 150 MHz 24 bit Scaler (one 50 ohms, one unterminated NIM input per scaler) | 2S 2024/24 | SEN | 1 | /70 | |
| | Microscaler (4×16 bit, 2×32 bit selectable, 25 MHz, common gate, NIM levels) | 1003 | Borer | 1 | 05/69 | |
| N | Quad CAMAC Scaler (4×16 bit or 2×32 bit, 40 MHz) | 1004 | Borer | 1 | | |
| C | Quad Scaler (4×16 bit, selectable 2×32 bit, 50 MHz, common gate, NIM levels) | S416L | EG+G | 1 | /71 | |
| | Quad 16-bit Spark Read-Out Register (20 MHz rate, TTL levels) | SR 1604 | GEC-Elliott | 1 | 01/71 | |
| | Serial Register (4×16 bit, 2×32 bit selectable, 25 MHz, common gate, NIM levels) | SR 1605 | GEC-Elliott | 1 | 01/71 | |
| | Quad 40 MHz Scaler (4×16 bit, 2×32 bit selectable, common gate, NIM levels) | SR 1606 | GEC-Elliott | 1 | 01/71 | |
| C | Serial Register (4×16 bit, 2×32 bit selectable, 100 MHz, common gate, NIM levels) | SR 1608 | GEC-Elliott | 1 | /71 | |
| | Microscaler (4×16 bit, 25 MHz, optimized input, 3 nsec, gives typ 80 MHz counting) | 003-4 | Nucl. Enterprises | 1 | /71 | |
| C | Quad Counting Register (4×16 bit, NIM input TTL Inhibit in, TTL Carry and OVF out) | 706-2 | Nucl. Enterprises | 1 | /71 | |
| | Quad Scaler | 9015 | Nucl. Enterprises | 0 | /71 | |
| | Microscaler (4×16 bit, 2×32 bit selectable, 25 MHz, common gate, NIM levels) | C 102 | RDT | 1 | 06/71 | |
| | Echelle Binaire 4×16 bits (Scaler, 30 MHz 2×32 bit selectable, common gate, NIM/TTL) | J EB 20 | SAIP-CRC | 1 | 01/71 | |
| | Four-Fold Scaler (4×16 bit, 2×32 bit selectable, 50 MHz, common gate, NIM levels) | 4 S 2003/50 | SEN | 1 | /69 | |
| | Four-Fold scaler (4×16 bit,2×32 bit selectable, 100 MHz, common gate, NIM levels) | 4 S 2003/100 | SEN | 1 | /70 | |
| | Four-Fold CAMAC Scaler (4×16 bit, 40 MHz, inputs A and B-NIM resp TTL-are ANDed) | 4 S 2004 | SEN | 1 | /70 | |
| N | Quad 25 MHz Scaler (4×16 bit, 2×32 bit selectable, common gate, NIM levels) | QS-003/25 | Techcal | 1 | 11/71 | |
| N | Quad 80 MHz Scaler (4×16 bit, 2×32 bit selectable, common gate, NIM levels) | QS-003/80 | Techcal | 1 | 11/71 | |

| N/C | DESIGNATION+SHORT DATA | TYPE | MANUFAC-TURER | WIDTH | DELIV. | NPR |
|---|---|---|---|---|---|---|
| N | Quad 100 MHz Scaler (4×16 bit, 2×32 bit selectable, common gate, NIM levels) | QS-003/100 | Techcal | 1 | 11/71 | |
| N | CAMAC Scaler (4×16 bit, 2×32 bit selectable, 30 MHz, common gate, LAM mask, TTL and NIM) | C-Z4-16 | Wenzel Elektronik | 1 | 11/71 | |
| | Quad Scaler (4×24 bit, 150/125MHz, Dataway and/or ext fast Inhibit, NIM levels) | S424 | EG+G | 1 | /71 | |
| C | Quad 100 MHz Scaler (4×24 bit, discr level −0.5V, time-interval appl, NIM Inhib I/P) | 84 | Jorway | 1 | 03/71 | (2) |
| C | Quad 100 MHz Scaler (4×16/24 bit, −0.5V I/P threshold, common ext fast Inhibit, NIM) | 2550B | LRS-Le Croy | 1 | 08/70 | |
| C | Quad Counting Register (4×24 bit, NIM input TTL Inhibit in, TTL Carry and OVF out) | 709-2 | Nucl. Enterprises | 1 | /71 | |
| C | Dual Counting Register (2×4 decades, separate ext Inhibit and Reset, OVF out) | 700-1 | Nucl. Enterprises | 1 | /71 | |
| | Dual Counting Register (2×3 decades, separate ext Inhibit and Reset, OVF out) | 7040-1 | Nucl. Enterprises | 1 | /70 | |
| N | Double Echelle 6 décades-100 MHz à affichage reporté (scaler with Reg O/P) | J EA 10 | SAIP-CRC | 1 | 11/71 | |
| | Quad BCD scaler (4×6 decades, 30 MHz) | 9021 | Nucl. Enterprises | 0 | /71 | |
| | Octal Scaler (12 bits, 8 inputs, 50 MHz, each scaler gives ext Inhibit, NIM levels) | S812 | EG+G | 1 | /71 | |
| | Bidirectional Counting Register (20 bit, with sign and Overflow) | 7071-1 | Nucl. Enterprises | 0 | /71 | |
| | Dual Coordinate Recorder | XYRCDR/042 | SAIP-CRC | 1 | 10/70 | |
| | Dual Incremental Position Encoder (2×20 bit X-Y digitization by up-down counter | 2IPE 2019 | SEN | 1 | 04/71 | |
| | **PRESET COUNTING MODULES** (Scalers, Timers) | | | | | |
| C | 24 bit BCD Preset-Scaler/Timer (10 MHz, NIM or TTL inputs, manual or Dataway preset) | FHC 1301A | BF Vertrieb | 2 | 01/71 | (1) |
| C | 24 bit BCD Preset-Scaler/Timer (10 MHz, NIM or TTL inputs, Dataway preset) | FHC 1302A | BF Vertrieb | 1 | 01/71 | (1) |
| N | Clock/Timer (0.001 sec to 10 hrs time interval, real-time output) | 1411 | Borer | 1 | /71 | (3) |
| | Preset Counting Register (16 bit, 10 MHz, NIM/TTL I/P, TTL Inhib+O/P, Dataway set) | 7039-1 | Nucl. Enterprises | 1 | /70 | |
| C | Preset Scaler (24 bit, 30 MHz, Dataway preset count/time, input gated, NIM levels) | 1001 | Borer | 1 | 06/71 | (1) |
| C | Preset Counting Register (24 bit, 10 MHz, Dataway set, NIM/TTL input, TTL O/P+Inhib) | 703-1 | Nucl. Enterprises | 1 | /71 | |
| C | Real Time Clock (needs ext clock, max 100 days period with 1 Hz pulses in, TTL I/O) | 712 | Nucl. Enterprises | 1 | /71 | |
| N | 24-bit Preset Scaler (counter-timer, input and gate are NIM, ext Inhibit is TTL) | C72451-A1330-A2 | Siemens | 0 | | (3) |
| N | CAMAC Preset-scaler (24 bit, 30 MHz, NIM signal and gate, ext Inhibit, man reset) | C-ZE-24 K | Wenzel Elektronik | 1 | 11/71 | |
| N | Preset Scaler (10 MHz, 8 decade BCD, display of 2 signif numbers+exp, man preset, NIM) | C 103 | RDT | 3 | 06/71 | |
| | Echelle 6 décades à Présélection (Scaler, man/Dataway preset, 1 MHz, start/stop O/P) | J EP 20 | SAIP-CRC | 2 | 01/71 | |
| | **PARALLEL INPUT REGISTERS** | | | | | |
| C | Parallel-Input-Register (single 16/24 bit opt, ready signals, I/O TTL, ADC appl) | MSP11 1230/1 | AEG-Telefunken | 1 | 10/70 | (1) |
| C | Parallel-Input-Register (single 16/24 bit opt, ready signals, I/O TTL, control bus) | MSP12 1230/1 | AEG-Telefunken | 1 | 10/70 | (1) |
| | Parallel Register (single 16 bit indicat, 50 nsec overlap required, TTL levels) | PR 1601-1 | GEC-Elliott | 1 | 06/71 | |
| | Priority Input Register (12 bits ORed to LAM, fast coinc latch appl, NIM levels) | 63 | Jorway | 2 | 10/70 | |
| | Interrupt Request Register (8 bit, TTL inputs to register, any input gives LAM) | 7013-1 | Nucl. Enterprises | 1 | /70 | |
| | Parallel Input Register (16 bit, continuous or strobed modes controlled by reg) | 7014-1 | Nucl. Enterprises | 1 | /70 | |
| | Strobed Input Register (12 bit coinc and latch, NIM levels, pattern and L-Reg appl) | SIR 2026 | SEN | 1 | /70 | |

| N/C | DESIGNATION+SHORT DATA | TYPE | MANUFAC-TURER | WIDTH | DELIV. | NPR |
|---|---|---|---|---|---|---|
| N | Input Register (24 bit, non-zero content sets LAM, register E/D from Dataway) | FHC 1308A | BF Vertrieb | 1 | 11/71 | |
| N | Universal Input/Output Register (36 bit data+range in, 12 bit reg O/P for control) | 1031 | Borer | 1 | /71 | (3) |
| N | 24-bit Status Change/Alarm Register (status compared, change gives LAM) | 1051 | Borer | 1 | /71 | (3) |
| | Parallel Register (dual 16 bit indicat, 6 nsec overlap required, NIM levels) | PR 1602 | GEC-Elliott | 2 | 01/71 | |
| C | Dual Parallel Register (2×16 bit indicat, 6 nsec overlap required, NIM levels) | PR 1604 | GEC-Elliott | 3 | 01/71 | |
| | Dual 16 bit Input Register (ext strobe or Dataway command stores data, TTL levels) | 2IR 2010 | SEN | 1 | /70 | |
| N | Dual 16 bit Input Register (continuous, strobed and one-strobe data entry, TTL) | PR-602 | Techcal | 1 | 11/71 | |
| | Dual Parallel Input Register (2×24 bit, ext load request, 4 oper modes, TTL levels) | 60 | Jorway | 1 | 10/70 | |
| N | Coincidence Buffer (2×12 bit, one strobe per 12 bits, min 2 nsec overlap, NIM inputs) | C212 | EG+G | 2 | /71 | |
| C | Fast Coincidence Latch (16 bit, discr I/P, min 2 nsec strobe-signal overlap) | 64 | Jorway | 1 | 01/71 | (1) |
| C | 16 Fold DCR (I/P discr, strobe-input overlap 2 nsec, CH1-8 and CH9-16 sum O/P, NIM) | 2340A | LRS-Le Croy | 2 | 05/71 | (2) |
| | 16-CH Coincidence Register (16 channels, strobe-input overlap 2 nsec, NIM levels) | 2341 | LRS-Le Croy | 2 | 01/71 | |
| | Pattern Unit (16 indiv NIM inputs, common NIM gate) | 021 | Nucl. Enterprises | 2 | /71 | |
| N | Pattern Unit (16 bit, I/P strobed with common gate, 10 nsec overlap, NIM levels) | C 101 | RDT | 2 | 06/71 | |
| | Pattern Unit 16 bit (16 individual NIM inputs, common NIM gate) | 16P 2007 | SEN | 2 | /70 | |

**PARALLEL INPUT GATES** (Dataway connecting)

| N/C | DESIGNATION+SHORT DATA | TYPE | MANUFAC-TURER | WIDTH | DELIV. | NPR |
|---|---|---|---|---|---|---|
| | Parallel Input Gate (16 bit, TTL input, 1 µsec integration of inputs) | 7017-1 | Nucl. Enterprises | 1 | /70 | |
| | Parallel Input Gate (16 bit, TTL input, ext strobe to input gates) | 7018-1 | Nucl. Enterprises | 1 | /70 | |
| C | Input Data Gate (24 bit negative logic TTL input, 1 = low) | 713 | Nucl. Enterprises | 1 | /71 | |
| C | Input Data Gate (24 bit positive logic TTL input, 1 = high) | 714 | Nucl. Enterprises | 1 | /71 | |
| | Parallel Input Gate (24 bit static data, integrated for 1 µsec, TTL levels) | 7059-1 | Nucl. Enterprises | 1 | /70 | |
| | Parallel Input Gate (22 bit static data, 500 nsec integration, strobe sets L, TTL) | 7060-1 | Nucl. Enterprises | 1 | /70 | |
| N | Digitales Eingangsregister (5×8 bit parall input gates, 5th Byte Sets L, TTL, 1 = h | DO 0200-2001 | Dornier | 1 | 11/71 | |
| N | Digitales Eingangsregister (5×8 bit parall input gates, 5th Byte sets L, HLL, 1 = h) | DO 0200-2002 | Dornier | 1 | 11/71 | |
| N | Digitales Eingangsregister mit Optokoppler (4×8 bit parallel input gates, with L) | DO 0200-2003 | Dornier | 1 | 11/71 | |
| | Dual Parallel Strobed Input Gate (2×24 bit handshake mode transfer to Dataway, TTL) | 61 | Jorway | 1 | 10/70 | |
| | Dual Parallel Input Gate (2×24 bit, non-interlock control transf to Dataway, TTL) | 61-1 | Jorway | 1 | 10/70 | |

**MANUAL INPUT MODULES**

| N/C | DESIGNATION+SHORT DATA | TYPE | MANUFAC-TURER | WIDTH | DELIV. | NPR |
|---|---|---|---|---|---|---|
| | Parameter Unit 12 bit (provides 12 bit communication, push button L-request) | P 2005 | SEN | 1 | /70 | |
| | Word Generator (24 bit word manually set by switches) | WG 2401 | GEC-Elliott | 1 | 01/71 | |
| C | Parameter Unit (quad 4-decade BCD parameters manually set) | 022 | Nucl. Enterprises | 4 | /71 | (2) |
| C | Word generator (24 bits of binary data, switch selected) | 9020 | Nucl. Enterprises | 1 | /71 | (2) |
| | Parameter Unit (quad 4-decade BCD parameters manually set) | C 105 | RDT | 4 | 06/71 | |

| N/C | DESIGNATION+SHORT DATA | TYPE | MANUFAC-TURER | WIDTH | DELIV. | NPR |
|---|---|---|---|---|---|---|
| **DATA STORAGE MODULES** | | | | | | |
| C | Quad Register (4×16 bit BCD or bin, load, clear and increment via Dataway) | 716-2 | Nucl. Enterprises | 1 | /71 | |
| C | Quad Register (4×24 bit BCD or bin, load, clear and increment via Dataway) | 717-2 | Nucl. Enterprises | 1 | /71 | |
| N | Mémoire Tampon (buffer memory, 256 13 bit Bytes, used with J can 20 C/H) | J MT 10 | SAIP-CRC | 1 | 11/71 | |
| **PARALLEL OUTPUT MODULES** | | | | | | |
| | 12 bit Output Register (dc or pulse O/P, updating strobe output, NIM levels) | 41 | Jorway | 1 | 03/71 | (2) |
| | output Register (12 bit, NIM pulses or levels out) | OR 2027 | SEN | 1 | /70 | |
| | Parallel Output Register (24 bit TTL output via 25-way connector) | 7054-3 | Nucl. Enterprises | 1 | /70 | |
| N | Digitales Ausgangsregister (4×8 bit parall output register, no L, TTL, 1 = h) | DO 0200-2501 | Dornier | 1 | 11/71 | |
| N | Digitales Ausgansregister (4×8 bit parall output register, no L, open coll O/P, 1 = h | DO 0200-2502 | Dornier | 1 | 11/71 | |
| N | Digitales Ausgangsregister (4×8 bit parall output register, no L, open coll O/P, 1 = l) | DO 0200-2503 | Dornier | 1 | 11/71 | |
| | Dual 16 bit output register (TTL levels, open coll outputs via cable) | 20R 2008 | SEN | 1 | /70 | |
| | Parallel-Output-Register (Dual 24 bit, or quad 12 bit, open collector output) | MSPO1 1230/1 | AEG-Telefunken | 1 | 10/70 | (1) |
| | Dual 24 bit Output Register (dc or pulse O/P, updating O/P strobe, TTL open coll) | 40 | Jorway | 1 | 07/71 | (2) |
| N | Digitales Ausgangsregister mit Reed-relais (4×8 bit output reg, open contact = 0) | DO 0200-2504 | Dornier | 2 | 11/71 | |
| | Readable Dual 16-bit Driver | OD 1601 | GEC-Elliott | 0 | 06/71 | (1) |
| C | Dual 16-bit Power Output Driver | OD 1605 | GEC-Elliott | 0 | 06/71 | (1) |
| | Driver (8 bit output via 15-way connector, 150 mA sinking capability, max 6V) | 7016-1 | Nucl. Enterprises | 1 | /70 | |
| | Switch (12 bit Dataway controlled relay register for switching and multiplexing) | 7066-1 | Nucl. Enterprises | 1 | /71 | |
| | Driver (16 bit, open collector output via multiway connector, max 150 mA/line) | 9002 | Nucl. Enterprises | 1 | /71 | |
| | Driver (24 bit output register, set and read by command, 24 bit I/P data accepted 1 multiway connector) | 9013 | Nucl. Enterprises | 1 | /71 | |
| | Driver (24 bit output register, set and read by command, 24 bit I/P data accepted 2 multiway connectors) | 9017 | Nucl. Enterprises | 1 | /71 | (1) |
| **DISPLAY MODULES AND UNITS** | | | | | | |
| C | Display (24 bit BCD display of one scaler FHC 1301/02, spec connection to scaler) | FHC 1305A | BF Vertrieb | 1 | 01/71 | (1) |
| C | Display (6 decade nixie for one of 12 scalers FHC 1301/02, spec bus to scalers) | FHC 1306A | BF Vertrieb | 2 | 01/71 | (1) |
| | CRT Decimal Display System (including) display driver | 72A<br>72A | Jorway | NA<br>3 | 07/71 | (2) |
| | Digital Display (part of 7000-ser multicrate system) | 0705-1 | Nucl. Enterprises | NA | /71 | (2) |
| | Display Driver (two 10 bit dac, output range +5V to −5V, two operation modes) | 7011-2 | Nucl. Enterprises | 2 | /70 | (1) |
| N | Decimal Display Unit (address and 5 data decades+multiplier displayed) | 9007 | Nucl. Enterprises | NA | /71 | |
| N | Display Controller (for 9007, includes bin to decimal converter) | 9006 | | 2 | /71 | |
| N | Indicator (1×16 bit or 2×8 bit, indicates state of register loaded from Dataway) | 9014 | Nucl. Enterprises | 1 | /71 | |
| | Storage Oscilloscope (driver for tektronix 611 or 601, used with 7011) | 9028 | Nucl. Enterprises | 0 | /71 | (2) |

| N/C | DESIGNATION+SHORT DATA | TYPE | MANUFAC-TURER | WIDTH | DELIV. | NPR |
|---|---|---|---|---|---|---|
| C | Affichage Décimal par l'Intermédiaire d'un Calculateur (display of 24 bit word) | J AF 15 | SAIP-CRC | 2 | 01/71 | |
| N | Affichage Binaire Manuel (content of a register displayed, ext multiway conn) | J AF 20 | SAIP-CRC | 1 | 01/71 | |
| C | Scope Display Driver X-Y-Z (system) | FDD 2012 | SEN | 1 | 04/71 | (1) |
| | Storage Display Driver for Tektronix 611 or 601 | SDD 2015 | | 1 | 04/71 | (1) |
| | Character Generator | CG 2018 | | 1 | 04/71 | (1) |
| | Vector Generator | VG 2028 | | 1 | 05/71 | (1) |
| **PERIPHERAL INPUT/OUTPUT MODULES** | | | | | | |
| C | Typewriter Drive Unit | TD 0801 | GEC-Elliott | 0 | 08/71 | (1) |
| C | Input-Output-Interface (teletype-Dataway I/O transf or 12 scaler O/P on spec bus) | FHC 1307A | BF Vertrieb | 2 | 01/71 | (1) |
| N | Teletype Interface | 90 | Jorway | 0 | 10/71 | |
| | Teletypewriter Driver (for ASR 33) | 7043-1 | Nucl. Enterprises | 1 | /70 | |
| | Teletypewriter Interface (I/O data transf and control, LAM used as two-way flag) | 7061-1 | Nucl. Enterprises | 1 | /70 | (1) |
| | Teletypewriter Terminal | TWTML/045 | SAIP-CRC | 1 | 10/70 | |
| | Paper Tape Punch Output Driver (for facit 4070) | TP 0801 | GEC-Elliott | 1 | 06/71 | (1) |
| C | Tape Reader Interface Unit (for electrographic reader) | TR 0801 | GEC-Elliott | 1 | 01/71 | (1) |
| | Stepping Motor Drivers (used with 7045) | 0706, 8, 9, 10 | Nucl. Enterprises | 1 | /71 | |
| | B.S. Interface Reader (8 bit data+parity bit, british standard) | 7057-1 | Nucl. Enterprises | 1 | /71 | |
| C | B.S. Interface Driver (8 bit data+parity bit, british standard) | 7058-1 | Nucl. Enterprises | 1 | /71 | |
| C | Peripheral Reader (8 bit parallel data in, neg or pos TTL, handshake controls) | 7064-1 | Nucl. Enterprises | 1 | /71 | |
| C | Peripheral Driver (8 bit data out, neg or pos TTL, handshake controls) | 7065-1 | Nucl. Enterprises | 1 | /71 | |
| C | Interface CAMAC Pour Codeur CA25/CA13/C97 (interfacing pulse ADC to CAMAC) | J CCA 10 | SAIP-CRC | 2 | 01/71 | |
| N | Step Motor Driver (max 32768 steps, rate, rotation and start/stop fully commanded) | 1161 | Borer | 1 | /71 | (3) |
| | Output Register (16 or 24 bit TTL driver for fast-routing multiplexer system) | CM 665 | J and P | 1 | 07/71 | |
| | Delayed Pulse Generator (4 TTL O/P, 0.042 Hz-40KHz, level and direction contr) | 7045-1 | Nucl. Enterprises | 1 | /70 | |
| N | MCA Interface (I/O module for multi-channel analyser) | | Packard | 3 | | |
| | Spark Chamber Read-Out | SCRO-041 | SAIP-CRC | 2 | 10/70 | |
| | Spark Chamber Read-Out Terminal | SCRO- TML-043 | | 5 | 10/70 | |
| N | Proportional Chamber Read-Out (used with spec controller type cofil or alone) | Refil | SAIP-CRC | 2 | /71 | |
| N | Sequential Output Register (serial-coded NIM pulses out, logic 0 = 40, 1 = 150 nsec) | SOR | SAIP-CRC | 1 | /71 | |
| N | Sequential Input Register (16 8 bit Bytes, stores coded NIM pulses, 0 = 40, 1 = 150 nsec) | SIRE | SAIP-CRC | 1 | /71 | |
| N | Plumbicon Read-Out | Plum | SAIP-CRC | 1 | /71 | |
| N | Plumbicon Read-Out Terminal | Pudding | | 1 | /71 | |
| | Dual Incremental Position Encoder (2×20 bit X-Y digitization by up-down counter) | 2IPE 2019 | SEN | 1 | 04/71 | |
| | Light Pen for FDD 2012 or CD 2018 | LP 2035 | SEN | NA | 06/71 | |
| | CAMAC Communications Controller Interface Unit | MC 4036 | Micro Consultant | 1 | 08/71 | (2) |
| | CAMAC Vid-Mos Interface Unit | MC 4037 | Micro Consultant | 1 | 08/71 | (2) |
| | CAMAC Mod 15 Interface Unit | MC 4038 | Micro Consultant | 1 | 08/71 | (2) |
| **MULTIPLEXERS** | | | | | | |
| N | 15 Channel Multiplexer (analogue signals routed to ADC/DVM, direct+scan modes) | 1701 | Borer | 1 | /71 | (3) |

| N/C | DESIGNATION+SHORT DATA | TYPE | MANUFAC-TURER | WIDTH | DELIV. | NPR |
|---|---|---|---|---|---|---|
| N | Elektronischer Multiplexer (16 channels, + or −10V range, Dataway set+Incr addr) | DO 0200-1031 | Dornier | 2 | 11/71 | |
| N | Elektronischer Multiplexer (32 channels, + or −10V range, Dataway set+Incr addr) | DO 0200-1032 | Dornier | 2 | 11/71 | |
| N | Elektronischer Multiplexer (16 diff I/P, + or − 10V range, Dataway set+Incr addr) | DO 0200-1033 | Dornier | 3 | 11/71 | |
| N | Elektronischer Multiplexer (32 diff I/P, + or − 10V range, Dataway set+Incr addr) | DO 0200-1034 | Dornier | 3 | 11/71 | |
| N | Relaismultiplexer (16 channels, max 200V/ 750 mA or 10 VA, Dataway set+incr addr) | DO 0200-1035 | Dornier | 2 | 11/71 | |
| N | Multiplexer-solid state (16 single-ended or 8 diff chan, random or sequent access) | 9026 | Nucl. Enterprises. | 1 | /71 | |

**CODE CONVERTERS**

| N/C | DESIGNATION+SHORT DATA | TYPE | MANUFAC-TURER | WIDTH | DELIV. | NPR |
|---|---|---|---|---|---|---|
| C | Binary to BCD-converter (24 bit bin, 8 decimal digit output via two connectors) | 7068-1 | Nucl. Enterprises | 1 | /70 | (2) |
| N | Binary to BCD-Converter (24 bit to 8 decade, display, conv 4 µsec, TTL level out, 1=h) | C-BBC-2 | Wenzel Elektronik | 2 | 11/71 | |

**ANALOGUE-TO-DIGITAL CONVERTERS** (ADC, DVM)

| N/C | DESIGNATION+SHORT DATA | TYPE | MANUFAC-TURER | WIDTH | DELIV. | NPR |
|---|---|---|---|---|---|---|
| N | Analoge Eingaenge (multiplexer-ADC, 8 I/P to one ADC, + or −10 V range, 8 bits/20 V) | DO 0200-1011 | Dornier | 2 | 11/71 | |
| N | Analoge Eingaenge (Multiplexer-ADC, 16 I/P to one ADC, + or −10 V range, 12 bits/20 V) | DO 0200-1012 | Dornier | 2 | 11/71 | |
| | 8-bit ADC (10 µsec) | ADC 0801 | GEC-Elliott | 0 | 06/71 | (1) |
| C | Multi-mode Linear ADC (8 bit, 40 MHz clock, area and peak modes, NIM levels) | 2243 A | LRS-Le Croy | 1 | 08/70 | (2) |
| N | Octal ADC (8 fast I/P, 8 bit/ch, 150 µsec conversion, common gate, NIM levels) | 2248 | LRS-Le Croy | 1 | 10/71 | |
| | Analogue to Digital Converter (8 bit, I/P range 0 to +5 V or 0 to −5 V, 25 µsec conv) | 7028-1 | Nucl. Enterprises | 1 | /70 | |
| | Convertisseur Analogique Numérique à 512 canaux (pulse ADC, 10 MHz clock, 0.1/10 V) | J CAN 31 | SAIP-CRC | 3 | 01/71 | |
| C | 10-bit ADC (13 µsec) | ADC 1001 | GEC-Elliott | 0 | 06/71 | (1) |
| | Dual 10 bit Digital Voltmeter (integrating type, −0.1 V to +0.1 V range) | 2DVM 2013 | SEN | 1 | 04/71 | |
| N | Dual Slope ADC (+ and − 0.01/1/10 V ranges, 11 bit resolution, 2 µsec conv time) | 1241 | Borer | 2 | /71 | (3) |
| N | Analoge Eingaenge (Multiplexer-ADC, 8 I/P to one ADC, + or − 10 V range, 12 bits/20 V) | DO 0200-1001 | Dornier | 2 | 11/71 | |
| N | Analoge Eingaenge (Multiplexer-ADC, 16 I/P to one ADC, + or − 10 V range, 12 bits/20 V) | DO 0200-1002 | Dornier | 2 | 11/71 | |
| N | Analoge Eingaenge (Multiplexer-ADC, 8 diff I/P to one ADC, + or − 10 V range, 12 bits/20 V) | DO 0200-1003 | Dornier | 2 | 11/71 | |
| N | Analoge Eingaenge (Multiplexer-ADC, 16 diff I/P to one ADC, + or − 10 V range, 12 bits/20V) | DO 0200-1004 | Dornier | 2 | 11/71 | |
| | 12-bit ADC (20 µsec) | ADC 1201 | GEC-Elliott | 0 | 06/71 | (1) |
| | A/D Converter (12 bit, max 20 µsec conversion, + and − 5 V, + and − 10 V, +10 V ranges) | 30 | Jorway | 2 | 06/71 | (2) |
| | Analogue to Digital Converter (12 bit, 20 µsec conversion, range −5 V to +5 V) | 7055-1 | Nucl. Enterprises | 1 | /70 | |
| N | Analoger Eingang (Dual slope 15 bit ADC, + or − 10 V range, 0.1 sec conversion) | DO 0200-1021 | Dornier | 1 | 11/71 | |
| C | Convertisseur Analogique Numérique Rapide à 8000 Canaux (pulse ADC, 100 MHz clock) | JCAN20C/JCAN20H | SAIP-CRC | 6 | 01/71 | |
| C | Interface pour Codeur J Can 20 et Bloc Mémoire BM 96 (ADC-memory interface) | J CAN 20 I | SAIP-CRC | 2 | 01/71 | |

**DIGITAL-TO-ANALOGUE CONVERTERS** (DAC)

| N/C | DESIGNATION+SHORT DATA | TYPE | MANUFAC-TURER | WIDTH | DELIV. | NPR |
|---|---|---|---|---|---|---|
| N | Analoge Ausgaenge (DAC, 12 bit resolution, + or − 10 V output range) | DO 0200-1501 | Dornier | 2 | 11/71 | |
| N | Analoge Ausgaenge (DAC, 12 bit resolution, + or − 10 V output range, 2 outputs) | DO 0200-1502 | Dornier | 2 | 11/71 | |
| | D/A Converter (12 bit, 5 µsec conversion, O/P ranges + and − 2.5 V/5 V/10 V and +5 V/10 V) | 31 | Jorway | 1 | 06/71 | (2) |
| | Digital to Analogue Converter (8 bit, output range 0 to +5 V or 0 to −5 V) | 7015-1 | Nucl. Enterprises | 1 | /70 | |

| N/C | DESIGNATION+SHORT DATA | TYPE | MANUFACTURER | WIDTH | DELIV. | NPR |
|---|---|---|---|---|---|---|
| | Dual Digital-to-Analog Converter (10 bit, output max 10.23 V or +5.11/−5.12 V) | 2DAC 2011 | SEN | 1 | 04/71 | |
| N | Dual Digital to Analog Converter (10 bit resolution, 10 nsec conv time, O/P 5V max) | DA-2000 | Techcal | 1 | 11/71 | |
| **TIME-TO-DIGITAL CONVERTERS** | | | | | | |
| N | Quad CAMAC Scaler (4×16 bit or 2×32 bit, 40 MHz) | 1004 | Borer | 1 | | |
| C | Time-to-Digital Converter (4×14 bit, clock rate 20 MHz, quad/dual/single config) | 1005 | Borer | 1 | /70 | |
| | Quad 16-bit Spark Read-Out Register (20 MHz rate, TTL levels) | SR 1604 | GEC-Elliott | 1 | 01/71 | |
| | Quad Time-to-Digital Converter (9 bit/CH, 102/510 nsec ranges, 13 µsec convers, NIM) | 2226A | LRS-Le Croy | 1 | 10/70 | (2) |
| N | Time Digitizer (5×16 bit, clock rate 40 MHz, with center finding logic) | TD 2031 | SEN | 1 | 11/71 | |
| N | Time Digitizer (4×16 bit, clock rate 70/85 MHz, NIM levels) | TD 2041 | SEN | 1 | 11/71 | |
| **OTHER ANALOGUE AND/OR DIGITAL MODULES** | | | | | | |
| | Fan-Out Unit (2 ORed inputs provide 8 true, 2 complem outputs, NIM signals) | FO 0801 | GEC-Elliott | 1 | 01/71 | |
| | Hex IL2 to IL1 converter (6 NIM signals in, 6 TTL signals out) | 7051-1 | Nucl. Enterprises | 1 | /70 | |
| | Hex IL1 to IL2 converter (6 TTL signals in, 6 NIM signals out) | 7052-1 | Nucl. Enterprises | 1 | /70 | |
| | Quin L1 to IL1 converter (5 harwell standard L1 signals in 5 TTL signals out) | 7053-1 | Nucl. Enterprises | 1 | /70 | |
| N | Differential Amplifier (ranges +0.1 V to −0.1 V and 0.5/5/50/500 C both polarities) | 9027 | Nucl. Enterprises | 2 | /71 | |
| N | Six-Fold Controlled Gate (indiv gating, fan-in and fan-out controlled by 3 regs) | 6CG 2017 | SEN | 1 | 11/71 | |
| **PULSE GENERATORS AND CLOCKS** | | | | | | |
| C | Timer (1 Hz to 1 MHz pulses-7 decades-over 7 TTL outputs, LAM by 1,10 or 100 Hz) | FHC 1303A | BF Vertrieb | 1 | 01/71 | (1) |
| | Crystal Controlled Pulse Generator (7 decades-1 Hz to 1 MHz-500 nsec pulses out, TTL) | PG 0001 | GEC-Elliott | 1 | 01/71 | |
| | Fast Test Pulse Generator (5 to 50 nsec NIM O/P pulse derived from S1.F(25) or ext) | TPG 0202 | GEC-Elliott | 1 | 01/71 | |
| | Clock Pulse Generator (7 outputs-1 Hz to 1 MHz-in decade steps, 10 MHz ext in, TTL) | 7019-1 | Nucl. Enterprises | 1 | /70 | |
| N | Clock Pulse Generator (7 decades-1 Hz to 1 MHz-500 nsec pulses out, TTL) | C 109 | RDT | 1 | 11/71 | |
| C | Horloge à Quartz 1 MHz (clock, 7 O/P-1 Hz to 1 MHz-200 to 800 nsec width, TTL level) | J HQ 10 | SAIP-CRC | 1 | 01/71 | |
| | Real Time Clock (3.8 µsec to 18.2 hrs, preset-time and preset-count modes) | RTC 2014 | SEN | 1 | 04/71 | |
| | Dual Programmed Pulse Generator (50 Hz/2 KHz/5 MHz pulse train, length by command) | 2PPG 2016 | SEN | 1 | 04/71 | |
| N | Time Base (70 MHz, used with TD 2031 and TD 2041) | TB 2032 | SEN | 0 | 11/71 | |
| C | Timer | C72454-A1450-A1 | Siemens | 0 | 10/70 | |
| N | CAMAC-clock-generator (7 decades-10 MHz to 1 Hz, 50/500 nsec O/P pulses, 2.8 V/50 ohms) | C-CG-10 | Wenzel Elektronik | 1 | 11/71 | |
| **LOGIC FUNCTION MODULES** | | | | | | |
| | Dual Gate (4 inputs/gate, logical and/or, nand/nor performed under control) | 7020-1 | Nucl. Enterprises | 1 | /70 | |
| | Fan-Out (3 inputs in logical combination A. or B, A. or. C, each with Fan-out of 4) | 7021-1 | Nucl. Enterprises | 1 | /70 | |
| N | Six-Fold Controlled Gate (indiv Gating, fan-in and fan-out controlled by 3 regs) | 6CG 2017 | SEN | 1 | 11/71 | |
| **DELAY AND ATTENUATOR UNITS** | | | | | | |
| | Dual Attenuator (50 ohms, Dataway controlled, range 0dB to 31dB in 1dB steps) | 9004 | Nucl. Enterprises | 1 | /71 | |

| N/C | DESIGNATION+SHORT DATA | TYPE | MANUFAC-TURER | WIDTH | DELIV. | NPR |
|---|---|---|---|---|---|---|
| | Atténuateur Programmable (man and Dataway control of attenuation, 0dB to 60dB) | J AT 10 | SAIP-CRC | 3 | 10/70 | |
| | **CRATES- NO POWER, NO DATAWAY** | | | | | |
| | CAMAC Crate (empty) | 2.080.000.6 | Knuerr | 25 | 10/70 | (2) |
| C | CAMAC Crate (empty, incl hardware supply chassis and ventilation panel) | 2.086.000.6 | | 25 | | (2) |
| N | Châssis CAMAC pour tiroirs modulaires, vides (empty crates) | | Polon | 25 | 08/71 | |
| | CAMAC System Bin (with modular supply) | | RO Associates | 25 | 03/70 | |
| | Châssis CAMAC Normalisé 5u (empty crate, 360 mm deep) | CM 5025 30 | Transrack | 25 | 10/70 | |
| | (460 mm deep) | CM 5025 40 | | 25 | | |
| | (525 mm deep) | CM 5025 50 | | 25 | | |
| | Châssis CAMAC 5u Utiles (empty crate, 6u total, 360 mm deep, ventilation hardware) | CM 5125 30 | Transrack | 25 | 10/70 | |
| | (460 mm deep) | CM 5125 40 | | 25 | | |
| | (525 mm deep) | CM 5125 50 | | 25 | | |
| | Châssis CAMAC 5u utiles (empty crate, total 6u, 360 mm deep, with one fan) | CM 5125 31 | Transrack | 25 | 10/70 | |
| | (460 mm deep) | CM 5125 41 | | 25 | | |
| | (525 mm deep) | CM 5125 51 | | 25 | | |
| | Châssis CAMAC 5u utiles (empty crate, 6u total, 360 mm deep, with two fans) | CM 5125 32 | Transrack | 25 | 10/70 | |
| | (460 mm deep) | CM 5125 42 | | 25 | | |
| | (525 mm deep) | CM 5125 52 | | 25 | | |
| | Crate (5u, empty) | MCF/5CAM/S | Imhof-Bedco | 25 | 06/71 | |
| | Crate (6u, empty, with ventilation baffle, harwell type 7000) | MCF/6CAM/SV | | 25 | | |
| | Crate (6u, empty, with ventilation baffle and removable panel, harwell 7000-ser) | MCF/6CAM/SVR | | 25 | | |
| | CAMAC Compatible Crate | NSI 875 dB/WV | Nucl. Specialties | 25 | 02/70 | |
| | Ventilated Crate No Power No Dataway | CCHN | RDT | 25 | 06/71 | |
| C | CAMAC Crate (5u non-ventilated, 380 mm deep) | 5UCAM | Willsher+Quick | 25 | 10/71 | (2) |
| N | (6u ventilated, no fan, 380 mm deep) | 6UCAM | | 25 | | (2) |
| N | (6u ventilated recessed, no fan, 430 mm) | 6URCAM | | 25 | | (2) |
| | **CRATES- WITH DATAWAY, NO POWER** | | | | | |
| | Ventilated Crate | VC 0010 | GEC-Elliott | 24 | | |
| | CAMAC Crate Verdrahtet (empty crate with wired Dataway) | 2.084.000.6 | Knuerr | 25 | 10/70 | (2) |
| N | Unpowered Crate with F.P.C. Dataway | 9 | MB Metals | 0 | 01/72 | |
| N | Crate with F.P.C. Dataway and Power Rail Assembly | TYPES 1, 2, 5, 6 | MB Metals | 0 | 01/72 | |
| | Crate | 7005-2 | Nucl. Enterprises | 24 | /70 | |
| N | Unpowered crate with dataway ( ) | CM 5125/33/A | Saphymo-SRAT | 25 | /71 | |
| | (360 mm) | CM 5125/33/D | | 25 | | |
| | ( ) | CM 5125/53/A | | 25 | | |
| | (525 mm) | CM 5125/53/D | | 25 | | |
| | Unpowered Crate with Dataway and Connectors | UPC 2029 | SEN | 25 | /70 | |
| | **CRATES- WITH DATAWAY AND POWER** | | | | | |
| N | Crate, Powered (see 1902, 1912, 1922) | 1902/12/22 | Borer | 25 | /70 | |
| | Crate Mainframe (crate system including the following) | 1902 | Borer | 25 | 12/69 | |
| | Power Pack, 270 VA | 1912 | | | 12/69 | |
| | Voltage Regulation Module (+ and − of 6V/9A, 12V/8A, 24V/7A) | 1922 | | | 12/69 | |
| | Regulator (+ or −6V) | 1925 | | | /71 | |
| | Regulator (+ and −12V or 24V) | 1926 | | | /71 | |
| | Alarm Unit | 1930 | | | 12/69 | |
| | Alarm Unit (Alternative to 1930) | 1931 | | | 12/69 | |
| N | CAMAC Crate (+6V/25A, −6V/5A, +12V/2A, +24V/4A, −24V/3A, 400W) | DO 0200-3001 | Dornier | 25 | 11/71 | |

| N/C | DESIGNATION+SHORT DATA | TYPE | MANUFAC-TURER | WIDTH | DELIV. | NPR |
|---|---|---|---|---|---|---|
| | Crates with Dataway and Power | 1250-0006 | Duckert | 25 | 06/71 | |
| | Powered Crate | MC100 | EG+G | 25 | /71 | |
| | Powered Crate (+ and −6V/25A, + and −24V/6A) | CPU/8 | Grenson | 24 | 09/71 | (2) |
| C | Power Crate (7005-2 crate with 9022 power supply) | 9023 | Nucl. Enterprises | 24 | /71 | (2) |
| N | Châssis et Tiroirs avec Alimentation (powered crate) | | Polon | 25 | 08/71 | |
| N | Powered Crate | CCHN-CSAN | RDT | 25 | 10/71 | |
| N | CAMAC Crate (powered by model 1410, ventilated) | 1410 NSI | Rodcor | 25 | 09/71 | |
| N | Châssis Alimentation (powered crate, ventilated, +6V/25A, −6V/15A, + and −24V/3A) | C ALJ 40 | SAIP-CRC | 25 | 11/71 | |
| C | Powered Crate (see P4 ALJ 13) | C4 ALJ 13 D | Saphymo-SRAT | 25 | /71 | (1) |
| C | Powered Crate (see P6 ALJ 13) | C6 ALJ 13 D | | 25 | | (1) |
| | Powered Crate (see P7 ALJ 13) | C7 ALJ 13 D | | 25 | | (1) |
| N | Power Supply (crate) | CM5125/53/D/BIP | Saphymo-SRAT | 25 | /71 | |
| N | Power Supply (crate) | CM5125/53/A/BIP | | 25 | | |
| C | Power Crate (300W max, +6V/25A, −6V/10A, + and −12V/3A, + and −24V/3A, 200V/0.05A) | PC 2006/A | SEN | 25 | 05/70 | |
| N | Power Crate (200W max, +6V/25A, −6V/10A, + and −12V/3A, + and −24V/3A, 200V/0.05A) | PC 2006/B | | 25 | 05/70 | |
| N | Power Crate (200W max, +6V/25A, −6V/10A, + and −24V/3A, 200V/0.05A) | PC 2006/C | | 25 | 11/71 | |
| C | Powered Crate (7u, vent, + and −6V/26A, + and −12V/6.5A, + and −24V/6.5A, 200V/0.1A, 200W) | | Siemens | 25 | 10/70 | (3) |

## POWER SUPPLIES AND SUPPLY CONTROLS

| N/C | DESIGNATION+SHORT DATA | TYPE | MANUFAC-TURER | WIDTH | DELIV. | NPR |
|---|---|---|---|---|---|---|
| | Power Supply (+ and −6V/25A, + and −24V/5A, 200V) | PS 0002 | GEC-Elliott | | 01/71 | |
| N | Compact Power Supply Unit 200/300W | PS 0003 | GEC-Elliott | | 10/71 | |
| | CAMAC Power Supply (+6V/20A, −6V/5A, + and −24V/5A, 200V/0.05A) | CPU/2 | Grenson | | 04/71 | |
| N | Same with Switched Metering | CPU/2M | | | 04/71 | |
| | Power Supply (+6V/20A, −6V/5A, + and −12V/2A, + and −24V/3A) | CPU/5 | Grenson | | 04/71 | |
| | Power Supply (rack mounting, +6V/25A, −6V/15A, + and −24V/5A, 200V/0.1A) | CPU/6 | Grenson | | 07/71 | |
| | Power Supply (rack mounting, +6V/25A, −6V/15A, + and −24V/5A, + and −12V) | CPU/7 | Grenson | | 07/71 | |
| N | Crate with F.P.C. Power Rail Assembly | TYPES 3, 4, 7, 8 | MB Metals | 0 | 01/72 | |
| | Power Supply (+6V/20A, −6V/5A, + and −24V/5A, 200V/0.05A) | 9001 | Nucl. Enterprises | | /71 | |
| C | Power Unit (+6V/15A, −6V/3A, + and −24V/2A, 200V/0.05A) | 9022 | Nucl. Enterprises | | /71 | (2) |
| | Power Supply (+ and −6V/25A shared, + and −12V/2A, + and −24V/6A shared, 200V) | 1031 | B. L. Packer | | 02/71 | |
| | Power Supply (+6V/25A, −6V/5A, + and −12V/2A, +and −24V/3A, 200V/0.1A) | C 303 | RDT | | 06/71 | |
| N | CAMAC Power Supply (+ and −6V/25A max 150W, + and −24V/6A max 150W, 12V and 200V OPT) | 1410 | Rodcor | | 09/71 | (3) |
| C | Power Supply Unit (+6V/10A, −6V/2A, + and −24V/1.5A) | P4 ALJ 13 | Saphymo-SRAT | | /71 | |
| C | (+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 | | | | |
| | Power Supply (max 300W, +6V/25A, −6V/10A, + and −12V/3A, + and −24V/3A, 200V/0.05A) | PS 2036 | SEN | | 06/71 | |

| N/C | DESIGNATION+SHORT DATA | TYPE | MANUFAC-TURER | WIDTH | DELIV. | NPR |
|---|---|---|---|---|---|---|
| | Power Supply Flexible System Comprising | CPU/1 | Grenson | | 07/71 | |
| N | Basic Crate (for supply modules, includes reference, control and 200V/0.1A) | CFC | | | | |
| | Supply Module (+6V/6A) | CFP/6 | | | | |
| | (−6V/6A) | CFM/6 | | | | |
| | (+12V/3A) | CFP/12 | | | | |
| | (−12V/3A) | CFM/12 | | | | |
| | (+24V/3A) | CFP/24 | | | | |
| | (−24V/3A) | CFM/24 | | | | |
| | Power Unit (for supply modules) | | RO Associates | | 06/71 | |
| | CAMAC System Power Supply Module (+ and −12V/72W, or +12V/6A or +24V/3A) | C 301 | | | 03/70 | |
| | (6V/10A) | C 210 | | | 03/70 | |
| | (6V/5A and 24V/1A) | C 211 | | | 03/70 | |
| | (6V/5A, +12V/0.4A, −12V/0.4A) | C 213 | | | 03/70 | |
| | (12V/4A) | C 250 | | | 06/71 | |
| | (24V/2A) | C 251 | | | 06/71 | |
| | Power Supply system (module options as follows) | C4 BIP 203 | Saphymo-SRAT | | /71 | |
| | Power Supply Module 6V 10A | BIP B6 10 | | | | |
| | 6V 15A | BIP C6 15 | | | | |
| | 6V 20A | BIP D6 20 | | | | |
| | 6V 40A | BIP E6 40 | | | | |
| | 12V 7A | BIP B12 7 | | | | |
| | 12V 10A | BIP C12 10 | | | | |
| | 12V 15A | BIP D12 15 | | | | |
| | 12V 25A | BIP E12 25 | | | | |
| | 24V 3.5A | BIP B24 35 | | | | |
| | 24V 6A | BIP C24 6 | | | | |
| | 24V 9A | BIP D24 9 | | | | |
| | 24V 15A | BIP E24 15 | | | | |
| | Supply Chassis 2kW (raw supply for regulator modules) | ALB/10 | Saphymo-SRAT | | /71 | (2) |
| | Fan Unit | VALB/10 | | | | |
| | Wired Rack 42u | BC 42 | | | | |
| | Power Supply Module 6V 5A (regulator) | BPR 605 | | | | |
| | 6V 10A | BPR 610 | | | | |
| | 6V 25A | BPR 625 | | | | |
| | 12V 2A | BPR 122 | | | | |
| | 12V 5A | BPR 125 | | | | |
| | 24 V 3A | BPR 243 | | | | |
| | 24 V 5A | BPR 245 | | | | |
| | Voltage Monitor Panel | MP 1 | GEC-Elliott | 0 | 01/71 | |
| N | Mains Switch Assembly | MS 3 | GEC-Elliott | 0 | 01/71 | |
| | Power Indicator (inserts into special station only, used with type 7005 crate) | 0704-1 | Nucl. Enterprises | 1 | /71 | |
| | Power Indicator plugs into any normal station) | 7074-1 | Nucl. Enterprises | 1 | /71 | |
| N | Supply Control Indicator | | B. L. Packer | 1 | 07/71 | |
| | Tiroir Modulaire de Commande (supply control module) | TCM 525 | Transrack | 1 | 10/70 | |
| | Netzteilchassis (empty supply chassis) | 2.082.000.6 | Knuerr | | 10/70 | |
| C | Power Unit Crate | 0700 | Nucl. Enterprises | | 01/71 | |
| N | Power Supply Crate (for separate supply) | CSAN | RDT | | 06/71 | |
| **VENTILATION EQUIPMENT** | | | | | | |
| | Luftereinheit (ventilation unit, complete with 3 fans and filter) | 2.081.000.6 | Knuerr | | 10/70 | |
| | (venlilation unit, no fan, no filter) | 2.085.000.6 | | | | |
| | Fan Unit (for ALB/10 supply system) | VALB/10 | Saphymo-SRAT | | /71 | |
| N | Ventilation Unit | 1UVCAM | Willsher+Quick | | 10/71 | (3) |
| **EXTENDERS AND ADAPTERS** | | | | | | |
| N | Extension Frame | EF 2 | GEC-Elliott | 1 | 10/71 | |
| | Extender Module | 11 | Jorway | 1 | 01/71 | |
| | Extension Unit | 7007-1 | Nucl. Enterprises | 1 | /70 | |
| | Module Extender | ME 2030 | SEN | 1 | 03/70 | |
| C | Prolongateur pour Tiroirs CAMAC (extender) | | Transrack | 1 | 10/70 | |
| | NIM Adaptor | 7009-2 | Nucl. Enterprises | NA | /70 | |
| | CAMAC NIM Adaptor | CNA 2033 | SEN | NA | 03/71 | |
| | NIM-CAMAC Adaptor | CAN | RDT | NA | 06/71 | |

| N/C | DESIGNATION+SHORT DATA | TYPE | MANUFAC-TURER | WIDTH | DELIV. | NPR |
|---|---|---|---|---|---|---|
| **MODULE PARTS** | | | | | | |
| | Black Module Kit (single width) | BM 1 | GEC-Elliott | 1 | 01/71 | |
| | (double width) | BM 2 | | 2 | | |
| | (triple width) | BM 3 | | 3 | | |
| | (quadruple width) | BM 4 | | 4 | | |
| | Single Card Mounting Kit (empty module) | BCK/5CAM/CM1 | Imhof-Bedco | 1 | 06/71 | |
| | Double Card Mounting Kit | BCK/5CAM/CM2 | | 2 | | |
| | Triple Card Mounting Kit | BCK/5CAM/CM3 | | 3 | | |
| | Quadruple Card Mounting Kit | BCK/5CAM/CM4 | | 4 | | |
| | Double Enclosed Bin Kit (empty module) | BCK/5CAM/BM2 | Imhof-Bedco | 2 | 06/71 | |
| | Triple Enclosed Bin Kit | BCK/5CAM/BM3 | | 3 | 06/71 | |
| | Quadruple Enclosed Bin Kit | BCK/5CAM/BM4 | | 4 | 06/71 | |
| | CAMAC-Kassette (empty module, width 1/25) | 2.090.001.8 | Knuerr | 1 | 10/70 | (2) |
| | (width 2/25) | 2.090.002 8 | | 2 | | |
| | (width 3/25) | 2.090.003.8 | | 3 | | |
| | (width 4/25) | 2.090.004.8 | | 4 | | |
| | (width 5/25) | 2.090.005.8 | | 5 | | |
| | (width 6/25) | 2.090.006.8 | | 6 | | |
| C | Chassis Kit (empty module, 1 unit width) | 7001 | Nucl. Enterprises | 1 | 01/71 | |
| C | (empty module, 2 units width) | 7002 | | 2 | 01/71 | |
| | Module Kit (empty module, 1 unit width) | 9005-1 | Nucl. Enterprises | 1 | /71 | |
| | (empty module, 2 units width) | 9005-2 | | 2 | /71 | |
| | CAMAC Compatible Module (empty module, 1 unit width) | NSI 875 dm | Nucl. Enterprises | 1 | 02/70 | |
| | (2 units width) | | | 2 | | |
| | (3 units width) | | | 3 | | |
| | Empty Module 1 unit | CCA 1 | RDT | 1 | 10/70 | |
| | 2 units | CCA 2 | | 2 | | |
| | 3 units | CCA 3 | | 3 | | |
| | 4 units | CCA 4 | | 4 | | |
| | Tiroir Modulaire (empty module, W = 1/25) | TM 50125 | Transrack | 1 | 10/70 | |
| | (W = 2/25) | TM 50225 | | 2 | | |
| | (W = 3/25) | TM 50325 | | 3 | | |
| | (W = 4/25) | TM 50425 | | 4 | | |
| | (W = 5/25) | TM 50525 | | 5 | | |
| | (** = 06, 08, 10 and 12 for corresp width) | TM 5** 25 | | | | |
| N | CAMAC Module (empty ,1/25 card module) | CAMCAS 1 | Willsher+Quick | 1 | 10/71 | (2) |
| N | (2/25) | CAMCAS 2 | | 1 | | (2) |
| N | (3/25) | CAMCAS 3 | | 3 | | (2) |
| N | (4/25) | CAMCAS 4 | | 4 | | (2) |
| N | CAMAC Module (empty, 2/25 screened module) | CAMMOD 2 | Willsher+Quick | 2 | 10/71 | (2) |
| N | (3/25) | CAMMOD 3 | | 3 | | (2) |
| N | (4/25) | CAMMOD 4 | | 4 | | (2) |
| | Blank Module (complete with printed board for 69 integrated circuits, 1u width) | BM 2020/1U | SEN | 1 | /70 | |
| | (same, 2u width) | BM 2020/2U | | 2 | /70 | |
| | Printed Circuit Test Board | 10 | Jorway | NA | 01/71 | |
| N | CAMAC-Universalkarte (printed card module with 28 14-pin+28 16-pin sockets) | DO 0200-2900 | Dornier | 3 | 11/71 | |
| N | PC Board (MX B1 has 68 sites, MX B2 has 80 sites) | MX B1/MX B2 | GEC-Elliott | NA | 10/71 | |
| N | (MX B3 has 68 sites, MX B4 has 80 sites, MX B3/MX B4 include 5V circuit) | MX B3/MX B4 | | NA | 10/71 | |
| | General Purpose IC Patchboard (max 33 14/16-pin and 5 24-pin dip, were wrap) | CAMAC CG 164 | GSPK | NA | 12/70 | (2) |
| | Experimentierplatte (printed circuit board) | 4.000.002.0 | Knuerr | NA | 10/70 | |
| C | Module Printed Circuit Boards (take 24 16-pin and 36 14-pin dip, CBP3 has sockets) | CBP1/CBP2/CBP3 | RDT | NA | 06/71 | |
| | Contrôleur Sortie Dataway (dataway test module) | | Transrack | 1 | 10/70 | |
| | Carte Circuit Imprimé CAMAC (printed circuit Board for CAMAC module) | | Transrack | NA | 10/70 | |
| **DATAWAY COMPONENTS** | | | | | | |
| | Dataway Connector | | AMP-Holland | | 10/70 | |
| C | Dataway Connector, Flowsolder Termination (add mounting brackets R500014900000000) | R500014800000000 | CARR Fastener | | 10/70 | |
| C | Mini Wrap Termination | R500016800000000 | | | 10/70 | |
| N | Solder Slot Termination | | | | 10/70 | |

| N/C | DESIGNATION+SHORT DATA | TYPE | MANUFAC-TURER | WIDTH | DELIV. | NPR |
|---|---|---|---|---|---|---|
| | Connecteur, Futs Droits (Dataway connector, straight pins) | K/47995 | FRB Connectron | | 01/70 | |
| | Futs Wrapping (wire wrap pins) | K/48326 | | | | |
| | Futs a Souder (solder pins) | K/49016 | | | | |
| | CAMAC-Leiste (Dataway connector, miniwrap) | 4.000.000.0 | Knuerr | | 10/70 | |
| | (solder pins) | 4.000.001.0 | | | | |
| N | Dataway Connector, (mini-wrap) | 2422 061 64334 | Philips | | 09/71 | |
| N | (board solder) | 2422 061 64354 | | | | |
| N | (wire solder) | 2422 061 64314 | | | | |
| C | Dataway Connector (wire solder) | EAA 043 D100 | SABCA | | 06/71 | |
| C | (flow solder to board) | EAA 043 D200 | | | 06/71 | |
| C | (miniwrap) | EAA 043 D301 | | | 06/71 | (2) |
| C | Connecteur 254 Double Face (Dataway connector, wire wrap) | 254 DF 43 AWV | Socapex | | 01/70 | |
| C | (motherboard solder) | 254 DF 43 AYV | | | 01/70 | |
| C | (wire solder) | 254 DF 43 AZV | | | 01/70 | |
| N | Dataway Connector (** = 15 for miniwrap, also solder lug and flow solder types) | 86068621**000 | Souriau | | 11/71 | |
| N | Dataway Connector (* = 2 flow solder, * = 3 solder lugs, * = 4 miniwrap, Au plating) | C 288* CSP 221 | UECL | | 11/71 | |
| N | (flow solder, Ni+Au plating) | C 2885 CSP 221 | | | | |
| N | (13 miniwrap, contacts, other are flow solder, Ni+Au plating) | C 2886 CSP 221 | | | | |
| N | (* = 7 miniwrap, * = 8 solder lugs, Ni+Au plating) | C 288* CSP 221 | | | | |
| | Dataway Assembly (film wire packaging) | | MB Metals | | 07/71 | (3) |
| | Dataway (motherboard, complete with 25 connectors) | CDW | RDT | | 10/70 | |
| N | Dataway (motherboard with 25 Dataway connectors) | J/D | Saphymo-SRAT | | 11/71 | |
| | CAMAC Multilayer (Dataway motherboard) | CM-8-69 | Tech and Tel | | 08/71 | |
| **BRANCH HIGHWAY COMPONENTS** | | | | | | |
| | Branch Highway Connector (fixed member, socket moulding) | WSS0132S00BN000 | Emihus-SABCA | | 10/70 | |
| | (free member, pin moulding, PXX YYY selects jackscrew) | WSS0132PXXBNYYY | | | | |
| | Hood (for free member) | WAC 0132 H005 | | | | |
| C | Branch Highway Cable (complete PTFE cable assembly, 27 cm long) | CD 18067-27 | Emihus | | 10/70 | |
| N | (1 meter long) | CD 18067/107 | | | 11/71 | |
| N | (2 meters long) | CD 18067/207 | | | 11/71 | |
| C | Branch Cable with Connector (1.5 ft long) | | Jorway | | 03/71 | |
| C | Cable for Branch Highway (PVC jacket) | 132 PE 189 | Precicable Bour | | 10/71 | |
| C | (braided rilsan jacket) | 132 PE 210 | | | | |
| | Branch Highway Cable Only (plain PVC jacket) | 66 POL PB | SABCA | | 06/71 | |
| | (woven rilsan jacket) | 66 RIL PB | | | | |
| | Branch Highway Cable Assembly (with connectors, 27 cm long) | CC 66 RIL PB-27 | SABCA | | 06/71 | |
| | (xx cm long, rilsan jacket) | CC 66 RIL PB-XX | | | | |
| | (xx cm long, PVC jacket) | CC 66 POL PB-XX | | | | |
| N | Cable pour Branch Highway (66 paires torsadées, 66 twisted pairs) | CL 90 | SAIP-CRC | | 11/71 | |
| N | Branch Highway Cables (complete with connector, lengths 27 cm and up) | | Tekdata | | 08/71 | |
| N | Cable Extension Module (joins two branch highway cables) | CD 18106 | Emihus | | /72 | |
| **OTHER STANDARD CAMAC COMPONENTS** | | | | | | |
| | Coaxial Connector | RA 00 C50 | Lemo | | 01/70 | |
| | 52-Way Double Density Connector (fixed member with pins. LAM grader connector) | 2 DB 52 P | Cannon | | 10/70 | |

*Note*

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

# INDEX OF MANUFACTURERS

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

AMP-Holland
Papierstraat 2-4, Postbus 288
S-Hertogenbosch, Netherlands

Berthold/Frieseke – See BF Vertrieb

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

N B. L. Packer Co. Inc.
5-05 Burns Avenue
Hicksville, N.Y. 11 801, USA

C Borer & Co. Electronics AG
Postfach
CH-4500 Solothurn 2, Switzerland

Cannon Electric, Ltd.
Lister road, Winchester road
Basingstoke, Hampshire, England

Carr Fastener Co. Ltd.
Station House, Darkes Lane
Potters Bar, Herts, England

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

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

Duckert – See Juergen Duckert

EG+G Inc.
Nuclear Instrument Division
35 Congress Street
Salem, Massachusetts 01970, USA

N Eisenmann Elektronische Geraete
Blumenstrasse 11
D-7500 Karlsruhe, Germany

EKCO – See Nuclear Enterprises

Elliott – See GEC-Elliott

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

Emihus-SABCA
See respectively Emihus and SABCA

FRB Connectron
30, Avenue Gabriel Peri
F-92 Gennevilliers, France

Frieseke – See BF Vertrieb

C GEC-Elliott Process Instruments Ltd.
Century Works, Lewisham
London SE13 7LN, England

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

C G S P K (Electronics) Ltd.
Hookstone Park
Harrogate, Yorks HG2 7BU, England

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

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

C Imhof-Bedco Ltd.
Ashley Works
Cowley Mills Road
Uxbridge, Middlessex, England

Interdata Ltd.
Station House, Harrow Road
Wembley, Middlessex, England

N Intertechnique
F-78 Plaisir, France

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

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

Jurgen Duckert Projekttechnik
Adam-Berg Strasse 5
D-8000 Muenchen 83, Germany

Knuerr – See Hans Knuerr

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

Lemo SA
CH-1110 Morges, Switzerland

LSR-Le Croy – See Le Croy

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

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

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

Nuclear Specialties Inc.
(Precision Metal Fabricators)
540 Lewelling Blvd
San Leandro, California 94579, USA

N Packard Instrument Company, Inc.
Subsidiary of AMBAC Industries, Inc.
2200 Warrenville Rd.
Downers Grove, Illinois 60 515, USA

Packer – See B. L. Packer

N Philips Ned. N.V.
Dept Elonco, Building VB 11
Eindhoven, Netherlands

Polon – See Zjednoczone

Precicable Bour
151, Rue Michel-Carre
F-95 Argenteuil, France

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

RO Associates Inc.
3705 Haven Avenue
Menlo Park, California 94025, USA

N Rodcor Industries Inc.
44 255 Fremont Bvld
Fremont, California 94 538, USA

SABCA (S.A. Belge de Construction
Aéronautique)
Chaussée de Haecht, 1470
B-1130 Bruxelles, Belgium

SAIP-CRC – See Schlumberger

SAPHYMO-SRAT
51, Rue de l'Amiral Mouchez
F-75 Paris 13e, France

Schlumberger Instruments
et Systèmes
Centre d'Instrumentation Nucléaire
38, Rue Gabriel Crié
F-92 Malakoff, France

SEN Electronique
31, Avenue Ernest Pictet
CH-1211 Genève 13, Switzerland

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

SOCAPEX (Thomson-CSF)
9, rue Edouard Nieuport
F-92 Suresnes, France

N Souriau et Cie
13, rue Gallieni, B. P. 119
F-92 Boulogne-Billancourt, France

Tech and Tel – See Technograph

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

Technograph and Telegraph Ltd.
Fleet
Aldershot, Hampshire, England

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

Telefunken – See AEG-Telefunken

Texas Instruments Ltd.
Dallas Road
Bedford, England

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

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

N Wenzel Elektronik
Lamontstrasse 32
D-8000 Muenchen 80, Germany

Willsher and Quick Ltd.
Walrow
Highbridge, Somerset, England

N Zjednoczone Zaklady Urzadzen
Jadrowych Polon, Bjuro Zbytu
Warszawa, Poland

# CAMAC BIBLIOGRAPHY

## Specifications

**CAMAC:** A Modular Instrumentation System for Data Handling. Description and Specification. Eur 4100 e, d, f, i. 44 p. Luxembourg 1969, (e = english, d = deutsch, f = français, i = italiano).

**CAMAC:** Organisation of Multi-Crate Systems. Specification of the Branch Highway and CAMAC Crate Controller Type A. EUR 4600 e, d, f, i (to be printed).
*(Preliminary Issue, November 1970. ESONE Committee.)*

**CAMAC:** A Modular Instrumentation System for Data Handling. Specification of Amplitude Analogue Signals. EUR 5100 e, d, f, i (to be printed).
*(Preliminary Issue, February 1971. ESONE Committee.)*

## Other documents


ZWOLL, K., SCHMIDT, H.H. and MÜLLER, K.D. A Computer Controlled Triple Axis Neutron Spectrometer with CAMAC Instrumentation. *Kernforschungsanlage Jülich*, Bericht Jül. 774—ZE-FF—59 p. Jülich 1971.

HEEP, W., OTTES, J. und TRADOWSKY, K. Konzept für Entwurf und Spezifizierung von CAMAC-Modulen. *Kernforschungszentrum Karlsruhe*, Externer Bericht 22/71-6, 15 p. Karlsruhe 1971.

FRIEDLE, T. und HEEP, W. Prüfgerät für CAMAC-Crates. *Kernforschungszentrum Karlsruhe*, Bericht KFK 1446, 14 p. Karlsruhe 1971.

DUCLOS, J. and SARQUIZ, M. Experiment on Pion-Proton Elastic Scattering Under 100 MeV. CAMAC Bull. No. 1 (1971) pp. 12-14.

MAY, F., HALLING, H., PETRECZEK, K. FOCAL Overlay for CAMAC Data and Command Handling. CAMAC Bull. No. 1 (1971) pp. 18-19.

WHITEHEAD, N.P. A Parallel Processing Coupler for CAMAC-Computer Systems. U.K.A.E.A. *Research Group*, Report AERE-R 6817, 8 p., Harwell 1971.

OTTES, J.G. CAMAC System Controller für CALAS-Endstelle. *Kernforschungszentrum Karlsruhe*, Bericht KFK 1412, 67 p., Karlsruhe 1971.

BISBY, H. Applications of CAMAC. U.K.A.E.A. *Research Group*, Report AERE - R 6794, 30 p., Harwell 1971.

DEIMLING, B., HEEP, W., KLEIN, D. und STIEFEL, W. Integrierendes Digitalvoltmeter und Meßstellenmultiplexer im CAMAC-System Typ LEM-52/9/1. *Kernforschungszentrum Karlsruhe*, Externer Bericht 22/71-5, 37 p., Karlsruhe 1971.

SIMMEN, A. Automatic Analysis of Sleep Encephalograms, CAMAC Bull. No. 1 (1971) pp. 5-6.

WARD, L.D. A Meteorological Data Logging System in the CAMAC Standard, pp. 7-11, CAMAC Bull. No. 1 (1971).

RICHARDS, J.M. Harwell 7000 Series CAMAC Controllers. U.K.A.E.A. *Research Group*, Report AERE - R 6723, 48 p., Harwell 1971.

HEEP, W. und STIEFEL, W. CAMAC-Hochspannungsmodul Typ LEM-52/15.1. *Kernforschungszentrum Karlsruhe*, Externer Bericht 22/71-3, 32 p., Karlsruhe 1971.

BOUHARROUR, S., GRUBER, P., LENHARDT, H. und OTTES, J. Ein Vielzähler-Experiment aus der Hochenergiephysik im CAMAC-System mit einem Telefunken-Rechner TR 86A. *Kernforschungszentrum Karlsruhe*, Bericht KFK 1191, 54 p., Karlsruhe 1971.

TRADOWSKY, K. Analoge Signale im CAMAC-System. *Kernforschungszentrum Karlsruhe*, Externer Bericht 22/71-4, 22 p., Karlsruhe 1971.

ISELIN, F. *et al.*, CERN-NP 057 CAMAC Interfaces and their Use. CERN-NP CAMAC *Note No. 31-00*, 29 p., Genève 1971.

HEEP, W. und STIEFEL, W. CAMAC-Modul zur Steuerung von Drehverstellungen, insbesondere mittels Motoren und Schrittmotoren, Typ LEM-52/17.1. *Kernforschungszentrum Karlsruhe*, Externer Bericht 22/71-2, 32 p., Karlsruhe 1971.

BISBY, H. Development of Modular Systems for Nuclear Instrumentation and Data Handling. *Nucl. Engng. Internat.*, p. 321-324, 16 (1971) and *Atom H.*, pp. 123-129, 175 (1971).

BISBY, H. (Editor). The CAMAC Scheme-A presentation at Harwell on 24th Sept. 1970. U.K.A.E.A. *Research Group*, Report AERE - R 6713, 40 p., Harwell 1971.

L'ARCHEVEQUE, R. and YAN, G. A Review of the CAMAC Concept. *Atomic Energy of Canada Limited*, Report AECL - 3806, 40 p., Chalk River 1971.

SARQUIZ, M. Système de Spectrométrie Nucléaire Connecté à un Calculateur (Standard CAMAC). *Bull. Inform. Sci. Tech.* Suppl. pp. 34-36, Vol. 157 (1971); *Bull. Instrumentation Nucléaire*, Vol. 43.

LEWIS, A. Parallel Organisation of CAMAC Processes U.K.A.E.A. *Research Group*, Report AERE - R 6601, 10 p., Harwell 1971.

LEWIS, A. A Basis for a Small Computer Modular Executive. U.K.A.E.A. *Research Group*, Report AERE - R 6600, 7 p., Harwell 1971.

WARD, L.D. The Use of the 7025 Programmed Dataway Controller in CAMAC Systems. U.K.A.E.A. *Research Group*, Report AERE - R 6677, 13 p., Harwell 1971.

SARQUIZ, M. Situation Générale du Système CAMAC. *Bull. Inform. Sci. Techn.* Suppl. pp. 6-9, Vol. 155 (1971; *Bull. Instrumentation Nucléaire*, Vol. 42.

DUCLOS, J. Utilisation du Système CAMAC pour l'Acquisition de Données d'une Expérience de Diffusion Pion-Nucleon. *Bull. Inform. Sci. Techn.* Suppl. pp. 20-21, Vol. 155 (1971); *Bull. Instrumentation Nucléaire*, Vol. 42.

SERVENT, M.J.M. Système CAMAC, Développement Industriel. *Bull. Inform. Sci. Techn.* Suppl. pp. 10-14, Vol. 155 (1971); *Bull. Instrumentation Nucléaire*, Vol. 42.

ISELIN, F. *et al.* Introduction to CAMAC. CERN-NP CAMAC *Note No. 25-00*, 52 p., Genève 1971.

POŽAR, F. Computer Controlled Multicounter Experiment. *Nucl. Instrum. Meth.* pp. 253-265, 91 (1971).

KLAISNER, L.A. NAL CAMAC Accelerator Control. IEEE Nucl. Sci. Symposium, New York, November 1970. In: *IEEE Trans. Nucl. Sci.*, 18 (1071) pp. 61-62, Vol. 2 (CAMAC Tutorial Issue).

DHAWAN, S. Yale - NAL CAMAC SYSTEM. IEEE Nucl. Sci. Symposium, New York, November 1970. In: *IEEE Trans. Nucl. Sci.*, 18 (1971) pp. 65-68, Vol. 2 (CAMAC Tutorial Issue).

MACHEN, D.R., BISWELL, L.R., CAMAC Systems at LAMPF. IEEE Nucl. Sci. Symposium, New York, November 1970. In: *IEEE Trans. Nucl. Sci.*, 18 (1971) pp. 63-64, Vol. 2 (CAMAC Tutorial Issue).

MACK, D.A. Summary of CAMAC: Status and Outlook. IEEE Nucl. Sci. Symposium, New York, November 1970. In: *IEEE Trans. Nucl. Sci.*, 18 (1971) pp. 69-70, Vol. 2 (CAMAC Tutorial Issue).


The entries in this bibliography are extracted from KFK Report 1471, September 1971, 'CAMAC-Bibliographie' and with the kind permission of the author (I. Tradowsky-Thal). Dr. K. Tradowsky of Kernforschungszentrum, Karlsruhe will be pleased to receive copies of any new CAMAC literature for inclusion in future editions of the CAMAC bibliography.

## SUBSCRIPTION FEES

**for one copy per issue and three issues per annum** B. Fr. 300.–*[T]**
**single copies B. Fr. 125.–***

*) or the equivalent value in another currency.
[T]) students, universities, study and research centres and associated members may receive a reduction of 30% on the subscription price if requested.
**) subscription period starts on January 1st and ends on December 31st, except for 1972, where the subscription period starts on April 1st and ends on December 31st, the subscription price being reduced to B. Fr. 200.

Quantity discount for bulk orders.

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

On special request orders can be sent by air-mail. In that case air-mail charges will be invoiced on real cost.