CAMAC
bulletin

A publication
of the
ESONE Committee

ISSUE No. 2
November 1971

CONTENTS OF THIS ISSUE

PRINCIPAL CONTENTS OF CAMAC BULLETIN No. 1

ESONE and CAMAC

APPLICATION NOTES

1. Automatic analysis of sleep encephalograms. A. Simmen.
2. A meteorological data logging system in the CAMAC standard. L.D. Ward.
3. Experiment on Pion-Proton elastic scattering under 100 Mev. J. Duclos, M. Sarquiz.

LABORATORY ACTIVITIES

1. CAMAC at CERN. F. Iselin *et al.*
2. FOCAL overlay for CAMAC data and command handling. F. May, H. Halling, K. Petreczek.

PAPERS RECEIVED FOR FUTURE ISSUES

The following papers have been received by the Editorial Working Group, and will be published in a later issue of CAMAC Bulletin:

A CAMAC system for control of a diffractometer by A.C. Burley and G.M. Prior (Nuclear Enterprises Ltd., Reading, England).

A standard port for communication with CAMAC peripherals by H. Klessmann, H. Pangritz and W. Waver (Hahn-Meitner-Institut, Berlin, Germany).

Implementation of some details in CAMAC Crate Controller Type A by D. Kollbach and W. Waver (Hahn-Meitner-Institut, Berlin, Germany).

Multichannel Analyser in CAMAC by D. Sanghera (EKCO Instruments Limited, Southend-on-Sea, England).

CONTRIBUTIONS TO FUTURE ISSUES

of the Bulletin to the following members of the Editorial working Group:

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

On the cover:

View of Ispra JRC, Lago Maggiore, Northern Italy. This is the largest nuclear research centre of the Commission of the European Communities. The ESONE Committee was formed at a meeting here in 1961.

CAMAC
bulletin

Editorial Working Group :

W. Attwenger
R. C. M. Barnes
W. Becker
H. Bisby
H. Meyer
O. P. H., Nicolaysen
M. Sarquiz

Editor:

R. C. M. Barnes

Correspondence to:

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

Printed and distributed by:

Commission des
Communautés Européennes
D.G.XIII - CID
29, rue Aldringen
Luxembourg

From the editor

This is the second issue of a publication produced by the ESONE Committee to bring you news about the CAMAC standard for modular data handling equipment and about associated computer programming techniques. 4000 copies of the first issue were printed and distributed. New readers should, if possible, refer to pages 2 and 3 of CAMAC bulletin no. 1, where the relationship between the CAMAC standard, the ESONE Committee in Europe, and the NIM Committee in the USA are explained.

To mark the close collaboration between the ESONE Committee and the USAEC NIM Committee, this issue includes a personal letter from Mr. L. Costrell (Chairman of the NIM Committee). The first of a series of introductions to CAMAC is also contributed by NIM.

For users of CAMAC equipment there is a product index which includes most currently available equipment, and also announcements of new products by the manufacturers. As in the previous issue, there are descriptions of CAMAC systems—see 'Application Notes' — and reports on items of interest from various laboratories — see 'Laboratory Activities'.

The vigorous programme of work to extend and support the CAMAC standard is highlighted in statements concerning the activities of the Working Groups.

This issue of the Bulletin has been made possible by voluntary assistance from several member laboratories of ESONE backed by willing contributors and the encouragement of the ESONE Committee. Even so, it could not have appeared without the generous help of the Commission of the European Communities in printing and distributing it free of charge.

The Editorial Working Group hopes to produce three issues of the Bulletin each year and welcomes contributions from readers. The response to this invitation made in Issue 1 has been most encouraging, so much so, that a few contributions are held over to Issue 3 because of lack of space in Issue 2. Nevertheless, the Working Group still welcomes descriptions of CAMAC systems, short announcements of new products, news of hardware and software and software developments and short papers from companies or laboratories describing topics of general interest and relevance to CAMAC.

Before this Bulletin appears the ESONE Committee will have held its 1971 general assembly and exhibition of CAMAC equipment at Saclay, France.

CAMAC Bulletin REPLY CARDS

Although many reply cards have been returned from the first issue of the Bulletin the Editorial Working Group believe that some readers have failed to respond. Therefore this Issue is being distributed to the original mailing list and, of course, to those readers who have completed a reply card. IF YOU WISH TO RECEIVE THE NEXT ISSUE OF THE BULLETIN COMPLETE A REPLY CARD NOW.

Please be careful to give your full name and address, exactly as needed for posting the CAMAC Bulletin to you. There are extra cards for your colleagues to complete should they also like a copy of the next issue.

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

I look forward to the CAMAC Bulletin serving as a vehicle for dissemination of CAMAC information. Those who have been active in CAMAC and NIM are well aware of the collaboration between the NIM Committee and the ESONE Committee of European Laboratories. However, since many CAMAC users may not be familiar with the extent of the NIM-ESONE interaction, I am taking this opportunity to deal briefly with this subject.

The NIM Committee has for some time recognized the need for a modular dataway system complementary to NIM and has maintained close contact with the ESONE Committee during the development of CAMAC. There has been considerable communication between the NIM Committee and ESONE as well as numerous discussions between NIM members and European laboratory staff members beginning with the initial dataway system concepts in 1966 that culminated in CAMAC. This interchange of views and information has helped assure that CAMAC would meet both European and U. S. needs.

A high point in the NIM-ESONE collaboration was the endorsement of CAMAC by the NIM Committee on March 10, 1970. The NIM Committee intends to continue its cooperation and contact with ESONE to further the advantages of what has become a truly international dataway system.

The experience with NIM has demonstrated the value of a standard module system and has been a considerable factor in the NIM Committee's enthusiasm for CAMAC as a dataway system. In the May/June issue of the IEEE publication COMPUTER, Editor J. H. Haynes discusses "The CAMAC Story" and, referring to the widespread use of NIM, states "As we look at the conglomeration of test equipment stacked precariously on our workbenches, we wonder why this kind of standardization couldn't have happened to the electronics industry as a whole!" Opportunities for wide application of CAMAC and NIM clearly exist at this time. The fruit is there for the picking.

Louis Costrell, Chairman
U. S. AEC NIM Committee

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.

N.W. Hill (NIM-CAMAC Analogue Signals Working Group), Oak Ridge National Laboratory – Oak Ridge, Tennessee.

AN INTRODUCTION TO CAMAC

by

Louis Costrell

(Chairman, AEC NIM Committee)
NATIONAL BUREAU OF STANDARDS, WASHINGTON DC, USA

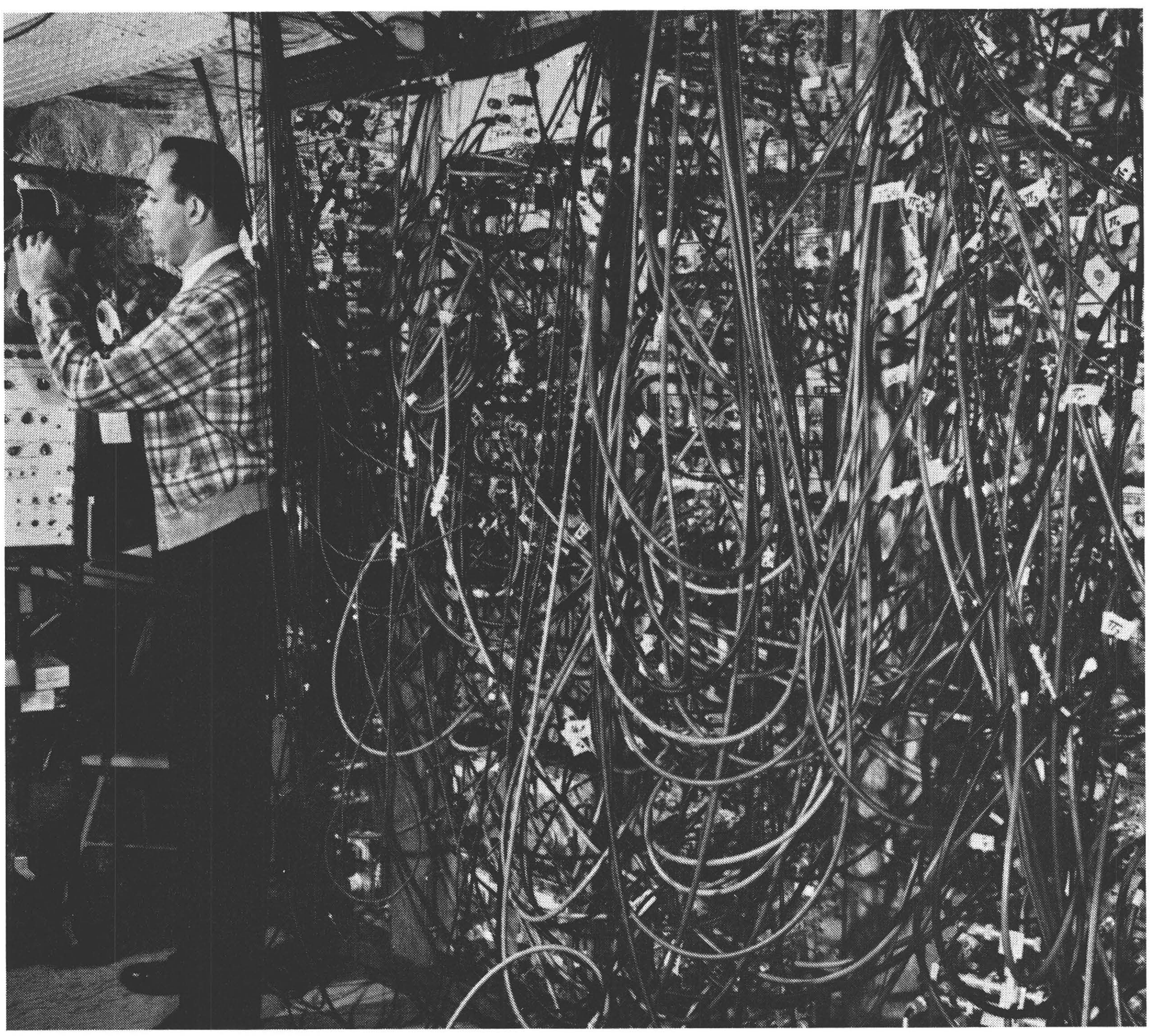
ABSTRACT *The CAMAC instrumentation system developed by the ESONE Committee of European laboratories has been endorsed by the US AEC NIM Committee as a dataway system complementary to the NIM (Nuclear Instrument Module) system. CAMAC is described in a general way in this condensed version of the introductory paper of the CAMAC Tutorial Sessions of the 1970 IEEE Nuclear Science Symposium.*

INTRODUCTION

CAMAC is an instrumentation system featuring a data highway (or dataway) by means of which modules can communicate with each other, with computers and with computer peripherals. It is a digital system that is capable of handling vast amounts of digital data.

The photograph shown here rather dramatically demonstrates the situation that inevitably led to dataway systems. This photograph shows some instrumentation at the Lawrence Radiation Laboratory in Berkeley in about 1963, before things became really complicated. Aesthetics aside, it is obvious that this installation could not begin to cope with the vast amounts of data generated today. One can either cram a dozen or more of these assemblies together and interlace them with an exponentially increasing number of cables or one can go to a dataway type system.

It seems that the systems designers and the experimentalists went in the direction of the dataway and the literature is full of descriptions of the various systems developed. As Fred Kirsten pointed out in San Francisco in November 1969, 'The data-bussing systems used by various laboratories and commercial firms in the United States share the common feature of being mutually incompatible.'

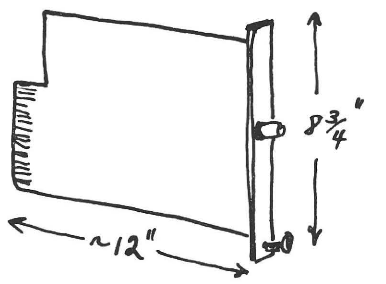


The ESONE Committee of European laboratories saw this coming and proceeded to develop the CAMAC system. The official CAMAC system specifications were published in March 1969. During the development of the CAMAC system there was a good deal of contact between the ESONE Committee and the NIM Committee and on March 10, 1970 the NIM Committee endorsed CAMAC as a dataway system complementary to NIM.

At the Nuclear Science Symposium held in San Francisco in October-November 1969[2], there was a panel discussion on the merits of interface standardization, and the pros and cons of CAMAC as seen through various eyes were very much a part of that panel discussion.

MODULES, CRATES AND DATAWAY

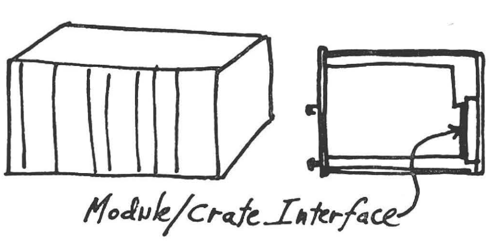
Now let us take a look at what comprises a CAMAC system. First, we have a module that looks something like this —



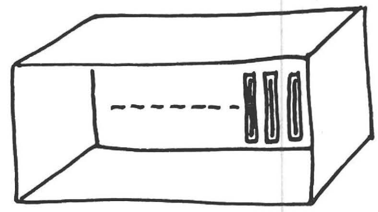
The front panel has a nominal height of $8\frac{3}{4}$ inch and a single-width is one half the width of a single NIM module—which makes it slightly under 0.7 inch. The length of the circuit board is almost exactly one foot to the end of the edge-connector. As is the case with NIM, modules can come in any multiple of the single-width, with the single and double-widths being especially popular.

The single-width module accommodates a single board with soldered-in IC's. Of course, a double-width module will handle two such circuit boards. However, if you go to wire-wrap type IC sockets, it is necessary to use a double-width module for a single board, but a greater number of integrated circuits can be mounted than is possible on a board using printed wiring. The usual assortment of digital circuits, registers, scalers, latches, etc. are built into the modules.

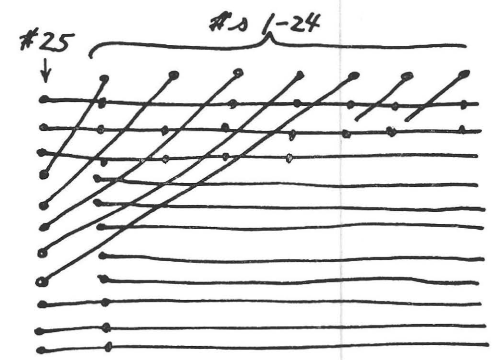
The module finds its home in a crate (or bin) that secures it mechanically and provides its interface to the dataway and to the power supplies.



The usual crate has provision for 25 single-width modules. So looking into the front of an empty crate we see 25 86-pin connectors like this —



for mating with 25 edge-connectors. If we turn the crate around and look at the back (and mentally unpeel some of the laminations that obscure things), we see the dataway that consists of a good deal of bussing and wiring something like this, but much denser —



These busses interconnect 24 of the connectors and some of the busses go also to the 25th connector.

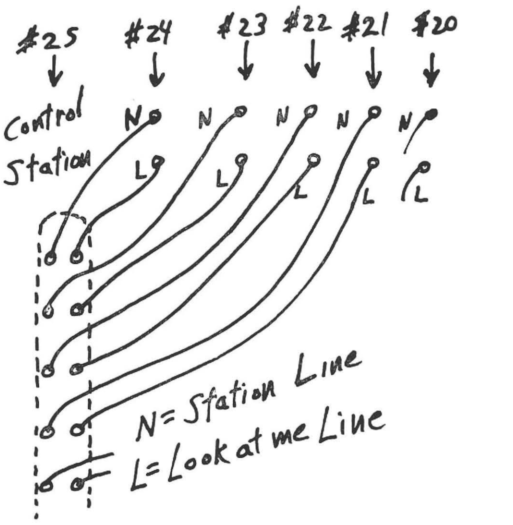
Power busses that go to all 25 connectors distribute the power which is predominately at plus and minus 6 V but includes also plus and minus 24 V. Plus and minus 12 V, plus 200 V and 117 V ac may also be included. However, the emphasis is on the 6 V and 24 V and both improved compatibility and power supply economy are the dividends one gets by avoiding the use of the other voltages.

You will note a number of diagonal lines between the 25th connector and the other connectors. The 25th connector (or 25th station) is apparently a different animal than the other 24 and we'll designate it as the Control Position or Control Station.

CONTROL STATION AND NORMAL STATIONS

The Control Station is the cross roads of the CAMAC system. All paths intersect at the Control Station. The diagonal lines are of two types—there are 24 'Station' lines (N lines), each of which connects to a separate Station and must be activated to communicate with the Station, and there are also 24 'Look at Me' lines (L lines) by means of which the individual modules signal the Control Station that they would like attention. The N lines and L lines are thus private lines as distinguished from party lines. Thus each N line and each L line is dedicated to a specific Station.

In addition to the dedicated lines that originate or terminate at the Control Station, there are a number of other lines that are bussed to the Control Station and to all of the other 24 Stations in true party line style. Twenty-four busses are assigned as *read* lines and 24 as *write* lines. These lines are not bussed to the Control Station but do connect to the other 24 Stations. The 24 Stations are all identical and are referred to as 'normal' Stations. The read lines transmit up to 24 bits of data *from* a module and the write lines transmit up to 24 bits of data *to* a module. You will note that data transfer is



unidirectional—separate lines are used for read and for write, which limits the amount of drive capability required of the modules.

In addressing a Station, the Control Station must activate the N line corresponding to the particular Station involved. In addition to activating the appropriate N line (which you will recall is a private dedicated line), coded Sub-address (A) lines and Function (F) lines are also activated to give a complete command to the module occupying the addressed Station. The Sub-Address lines and Function lines are fully bussed to all Stations. Decoding is done within the modules.

Thus to address a module calls for transmitting N, A, and F signals which we refer to as a NAF and here's the way it looks —

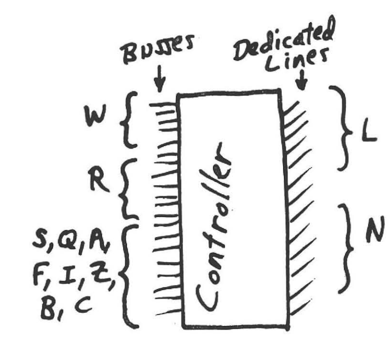
station Number .
sub Address
Function

Two strobe lines, S1 and S2, are also bussed to all Stations. The strobe signals are generated in time sequence on the two busses and are absolutely essential for transfer of data or to initiate operations. Other busses include Busy (B), Response (Q), Initialize (Z), Inhibit (I) and Clear (C). To a great extent the functions of these busses are apparent from their names but it is necessary to deal with them in some detail and this has been done in other papers[1].

CONTROLLER, BRANCH DRIVER AND BRANCH HIGHWAY

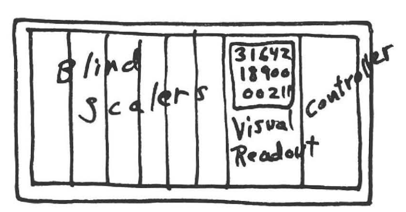
Now I would like to return to the maverick station that we've labelled the Control Station. Actually, the Control Station, as its name implies, issues commands or passes on commands (depending on who's in charge) to the various modules. The heart of the CAMAC system is the *Controller*. The Controller occupies the Control Station where it sends out N signals to the modules and sits and waits for L signals from modules that are frantically transmitting 'Look at Me' signals. Of course, it is necessary for the Controller to have access to all busses including the read lines and the write lines though, as we have noted, these lines do not connect to the No. 25 Station. The solution is really quite simple—the Controller must occupy a minimum of two slots with one of its connectors mating at Station 25 and a second connector mating at say Station 24. Thus the Controller has one connector that goes to the N and L lines and to some of the busses and another connector that goes to all busses.

The Controller speaks directly to the modules and the modules speak to the Controller. Modules cannot speak to each other or to the outside world without the Controller acting as intermediary. Modules are, in general, simple minded individuals. They do what they are told to do. That's not entirely the case since modules can send out L signals to tell the Controller that they'd like some attention and they can provide status signals. But the modules lean very heavily on the Controller and are essentially powerless without it. So taking advantage of its two connectors to gain access to all busses and all lines as we see here —

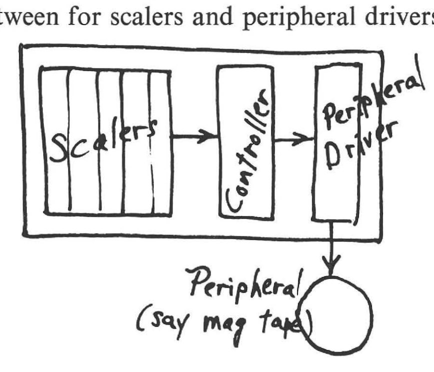


the Controller is really a communication center and it can instruct and interconnect as it sees fit — within certain ground rules of course.

In self contained systems — and a simple example would be a crate full of blind scalers with a common crate mounted display—the Controller would speak only to the modules and the modules would speak only to the Controller.

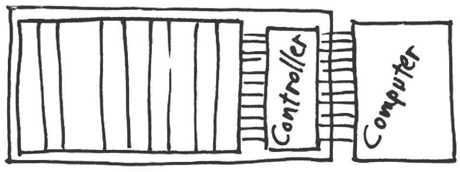


In other instances the Controller can be the go-between for scalers and peripheral drivers.

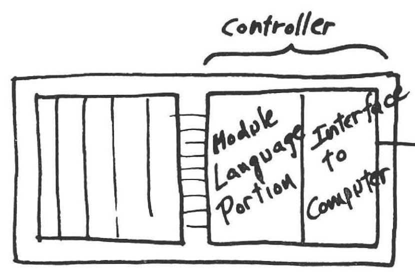


I've shown a one-way-flow from scalers to Controller to peripheral driver to peripheral. Actually, there's a two-way conversation as the Controller issues instructions to the scalers and looks for status information from the various modules.

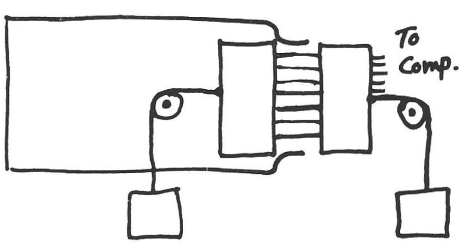
Where computers are involved, and this is the case more and more each day, the Controller communicates with the computer directly or indirectly. So the controller conducts two-way conversations with the modules and with the computer.



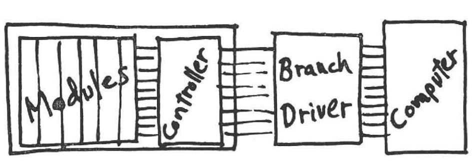
This means that the Controller must speak a language that the computer can understand and thus, to a greater or lesser extent, it functions as an interface to the computer. One can then tailor the Controller to a specific computer or can strike a balance between versatility and complexity. In either case, the concern is only with the conversation between Controller and computer since the Controller-to-module language is fixed and is not dependent on the computer used. One can look at the Controller in this way —



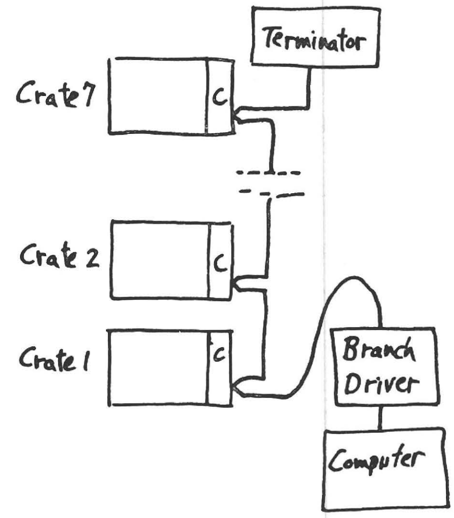
and as I've mentioned the right hand side has some interest in the computer with which it is associated. Of course we can pull the two halves apart —



and after patching up the hole and changing names somewhat it ends up like this —



Lo and behold the Controller is now utterly and completely independent of the computer and only the Branch Driver has to worry about the computer. The Branch Driver is used in what is called the Branch Highway system that was adopted as an ESONE standard in October 1970. This brings us to multicrate systems. The Branch Highway, utilizing the Branch Driver, can handle up to 7 crates. Each crate has its own Controller with the Branch Highway daisy-chained to all of the Controllers as shown here —



Again we note that the Controller communicates with its own crate and with the Branch Driver and has no interest in the type of computer involved.

The Branch Highway includes 7 crate address lines to provide a dedicated line for each crate. Earlier we dealt with the NAF addressing command but when we're concerned with more than one crate the address becomes CNAF, which is more properly CRNAF (since CR stands for crate and C for clear) but you'll have trouble pronouncing it that way.

Station, Function and Sub-address lines are contained in the Branch Highway but the Controller of the addressed crate assumes responsibility for routing these commands (and all other commands) within its own family. Data transfer is bidirectional since the high drive requirements, being restricted to the Branch Driver and the Controllers, are not much of a problem. Thus we have a total of 24 lines in the Branch Highway for read and write. The timing signals and timing operations of the Branch Highway involve 'handshake' type operations to make the system operation independent of signal transit times in the Branch Highway.

The Branch Highway is, of course, not the only means of operating multicrate systems and alternative approaches have been used.

CONCLUSION

This bird's eye view of CAMAC is intended to serve as an introduction for the details.

REFERENCES

1. CAMAC Tutorial Issue. IEEE *Trans. Nucl. Sci.*, Vol. NS-18, No. 2, April 1971, pp. 3-70.
2. **GOODMAN, C.D.** (Editor) On the Merits of Interface Standardization. IEEE *Trans. Nucl. Sci.*, Vol. NS-17, No. 1, February 1970, pp. 376-382.

1

ENSEMBLE DE MESURES AUTOMATIQUES
(AUTOMATIC MEASURING SYSTEM)

par

Guy Dupuy

CEN SACLAY, FRANCE

SUMMARY This paper describes a system designed for automatic measurements of device characteristics by means of a set of programmable generators and instruments connected to the device under test. The whole system is interfaced to the computer by CAMAC equipment. In one crate are all the various analogue-to-digital converters, digital-to-analogue converters and multiplexers which are necessary for the computer to handle the various parameters of the measuring instruments and the corresponding data.

GÉNÉRALITÉS

On présente un ensemble de mesures, associé à un calculateur pour exécuter le déroulement automatique des mesures suivant un programme enregistré. L'ensemble que nous décrivons a été étudié dans le but de permettre d'effectuer des mesures s'étendant du domaine continu aux fréquences de l'ordre de 1 000 MHz.

Le nombre important des appareils programmables qu'il contient permet de le considérer comme un ensemble de mesures général.

Son originalité réside principalement dans l'interface modulaire, réalisé dans le standard CAMAC. Les fonctions 'écriture' et les fonctions 'lecture' sont chacune groupées dans des tiroirs spécialisés (JDNA 10, JDN 10 pour les fonctions 'écriture', JMXNR 10, JCVN 10 pour les fonctions 'lecture').

L'ensemble peut, par le changement du tiroir 'contrôleur de châssis', être piloté par n'importe quel calculateur.

Il est particulièrement destiné aux mesures sur les circuits linéaires et sur les circuits logiques sous environnements variables (telles que les tensions d'alimentation continues et alternatives, température, etc. ...).

Son utilisation peut être intéressante pour l'analyse des circuits intégrés à large intégration où il est indispensable de faire un grand nombre de mesures.

ORGANISATION

Il comprend six parties principales (*figs. 1 et 2*):

A) le calculateur et ses périphériques,

B) l'interface général contenu dans un châssis CAMAC,

C) l'ensemble des générateurs programmables,

D) le réseau de commutation programmable à très large bande,

E) l'environnement variable et programmable dans lequel sont placés les appareils en essais,

F) l'ensemble des appareils de mesures programmables.

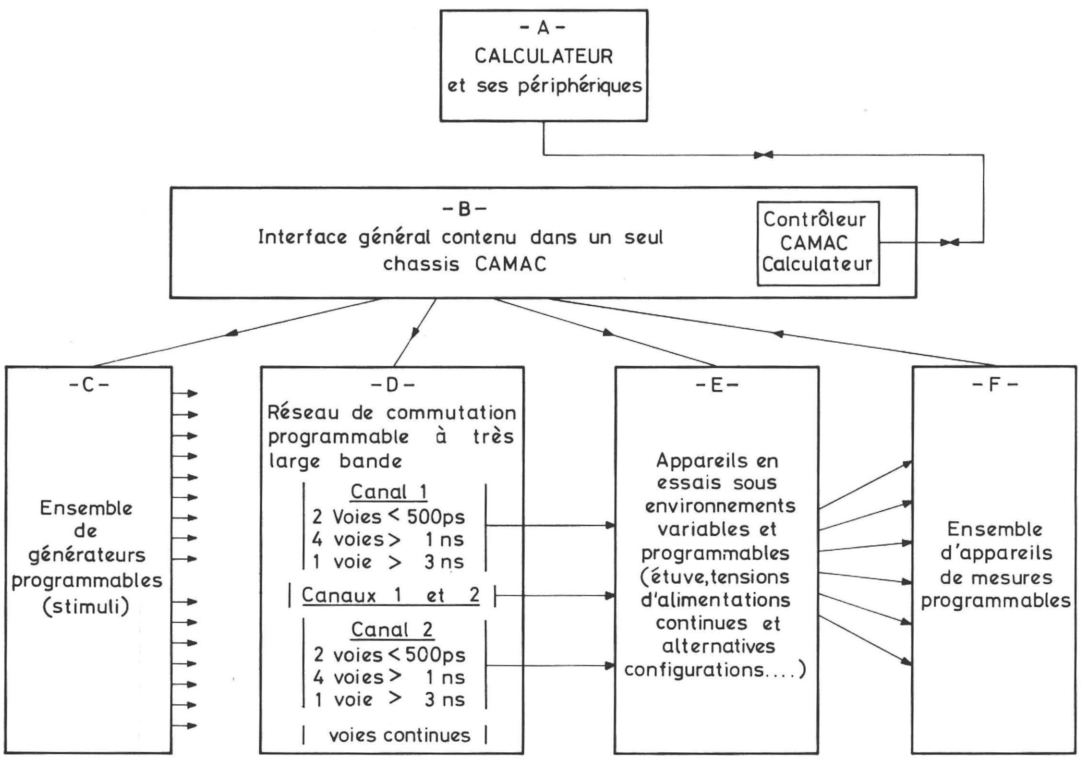


Fig. 1 Ensemble de mesures automatiques de réponses impulsionnelles sous environnements programmables. Schéma synoptique.

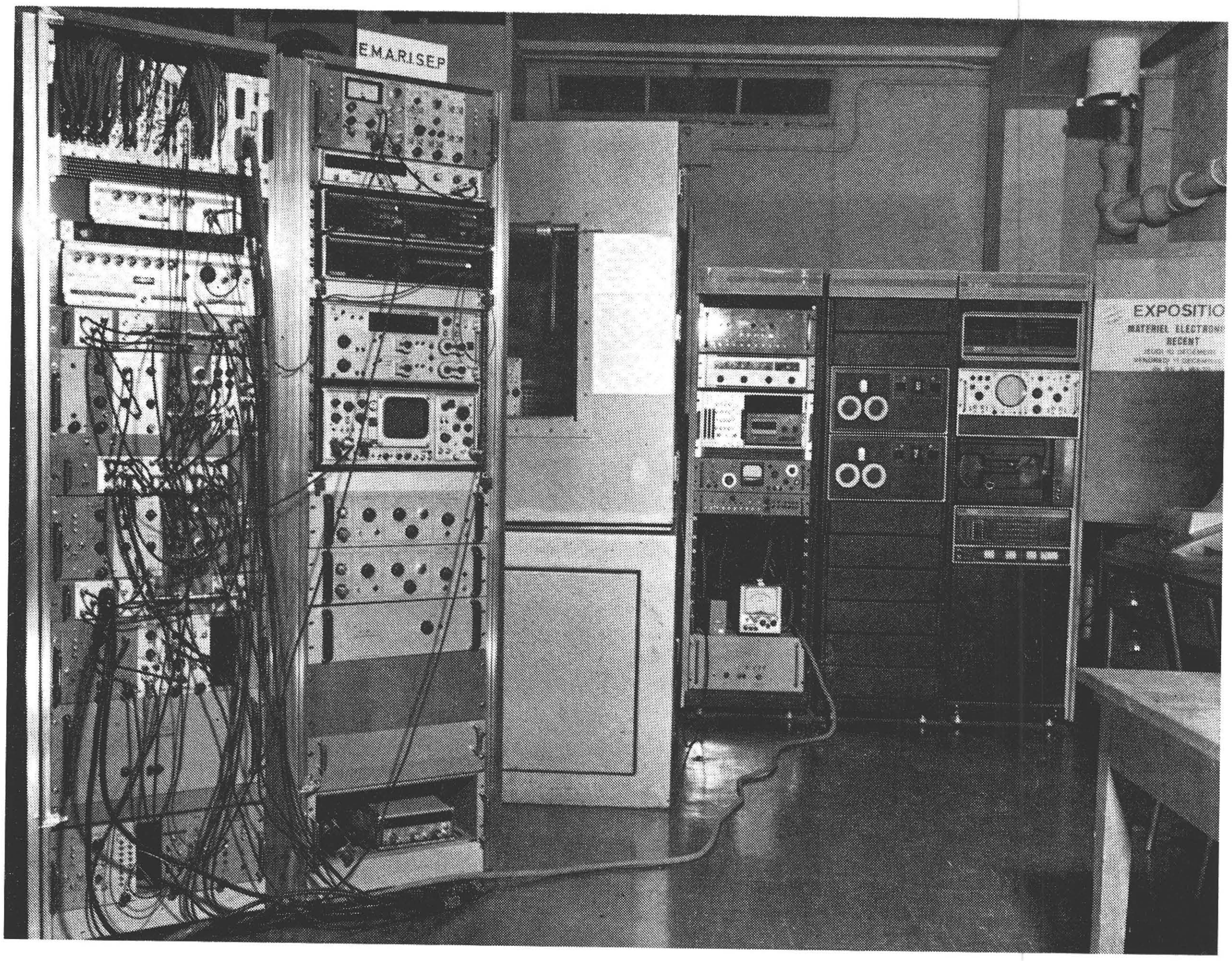


Fig. 2 Ensemble de mesures automatiques de réponses impulsionnelles sous environnements variables.

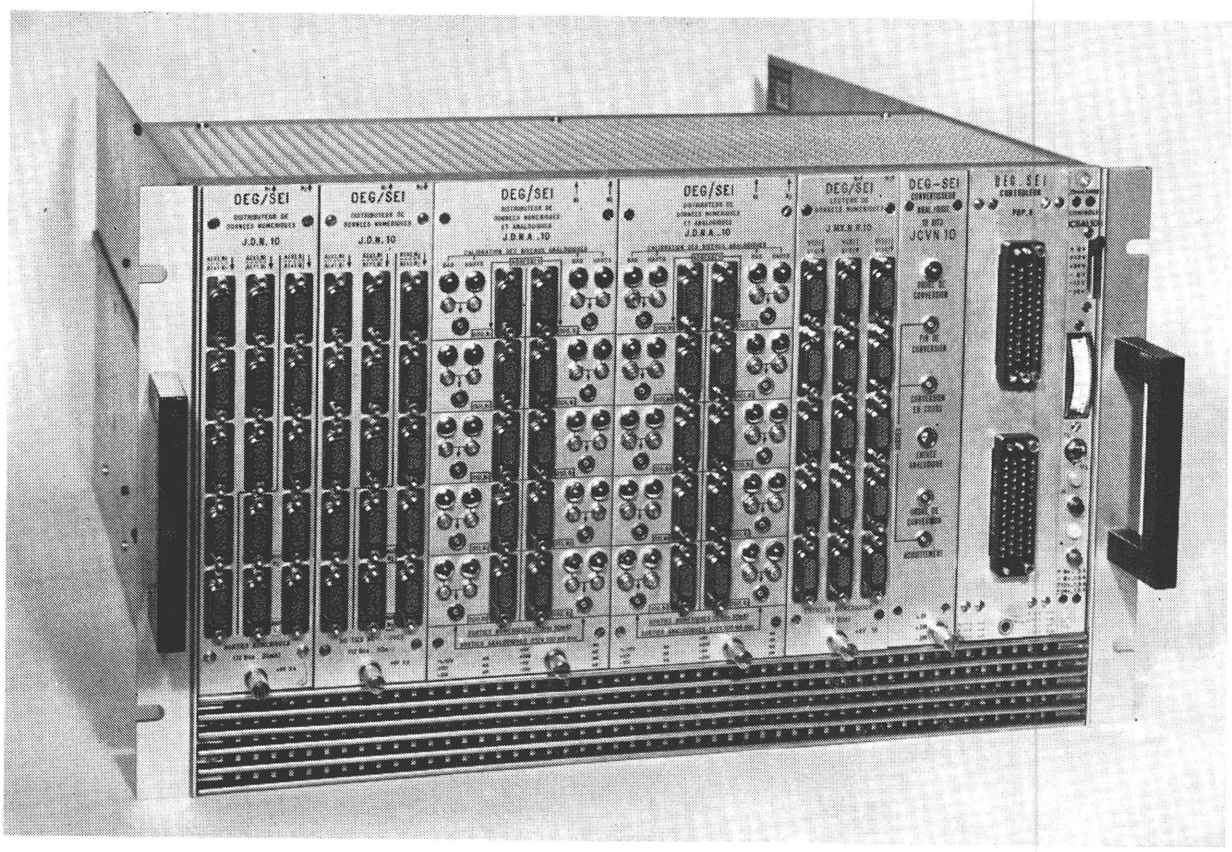


Fig. 3 Interface général (châssis CAMAC)

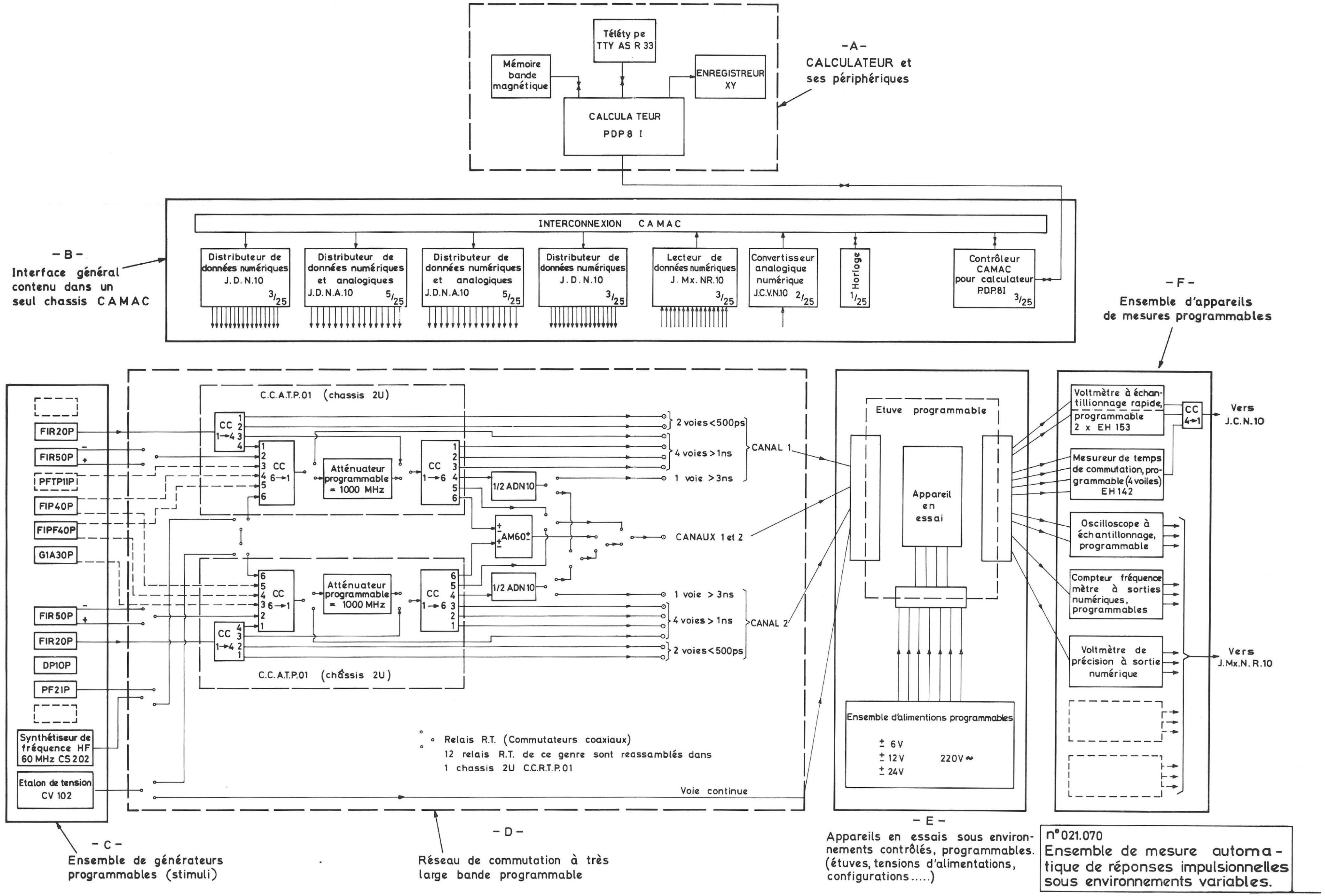


Fig. 4 Ensemble de mesures automatiques de réponses impulsionnelles sous environnements variables. Schéma synoptique.

A. On utilise ici un calculateur PDP-8I. Un tiroir spécialisé adapte ses exigences à celles du standard CAMAC (adaptation des niveaux, adaptation du format des mots et prise en compte des appels). Une télétype (TTY ASR 33) est reliée directement au calculateur et permet d'imprimer les résultats des mesures. Le calculateur dispose, grâce à une extension, de 16 k 'mémoire'. Les programmes et les sous-programmes peuvent être enregistrés sur bandes magnétiques.

B. L'interface général de l'ensemble de mesure est réalisé dans un châssis CAMAC sous forme modulaire et suivant les recommandations concernant ce système (EUR 4100 f). L'interface comprend deux parties principales :

1) Les tiroirs d'écriture (2 tiroirs JDNA 10 et 2 tiroirs JDN 10).

Tiroir JDNA 10 (distributeur de données numériques et analogiques).

Il reçoit séquentiellement les informations, décode les adresses et garde en mémoire les mots qui leur correspondent. Il comprend 6 voies à sorties numériques (12-bits chacune) et 10 voies à sorties à la fois numériques et analogiques. L'amplitude de sortie et son niveau de référence sont réglables séparément sur chaque sortie analogique.

Les valeurs analogiques sont obtenues par des cartes de conversion numérique-analogique (de 10-bits) enfichables; cette fonction permet de réaliser la programmation des verniers des différents appareils avec une grande souplesse. Les plages de chaque vernier peuvent être parcourues en 1024 points.

Tiroir JDN 10 (distributeur de données numériques)

Son rôle est le même que celui du tiroir JDNA 10, mais il n'y a pas de sortie analogique. Il dispose de 16 voies numériques de 12-bits chacune. Les niveaux logiques des sorties numériques sont des niveaux du type TTL.

Les sortances par bit des tiroirs JDNA 10 et JDN 10 sont élevées (30 mA) et les liaisons entre l'interface général et les différents appareils programmables peuvent être de ce fait très longues (supérieures à 15 mètres).

Sur chaque connecteur numérique des tiroirs JDNA 10 et JDN 10 on peut disposer d'une sortie de la tension d'alimentation TTL, d'une sortie du signal d'échantillonnage (SI) des fonctions écriture, et d'une entrée d'un signal 'alarme'.

2) Les tiroirs de 'lecture' (1 tiroir JMXNR 10, 1 tiroir JCVN 10).

Ces tiroirs sont destinés à recueillir les résultats des mesures et à les transférer vers le calculateur par l'interconnexion CAMAC.

Tiroir JMXNR 10

C'est un multiplexeur numérique de 16 voies de 12-bits + 1 bit d'appel, destiné à enregistrer et à lire les résultats des appareils de mesures qui se présentent sous la forme numérique. Les voies peuvent être explorées à une cadence supérieure à 50 kHz. Les incrémentations d'adresse, leur remise à zéro, les inhibitions des mesures peuvent être réalisées soit par l'interconnexion CAMAC, soit par des signaux extérieurs, avec une possibilité de sortie de l'état du registre d'adresse. Les sorties numériques des tiroirs JDNA 10 et JDN 10 peuvent être lues par le tiroir JMXNR 10.

Tiroir JCVN 10 (codeur analogique-numérique à poids de 11 bits + signe).

Il est destiné à lire les résultats présentés sous forme analogique par les appareils de mesures, en les codant en valeur numérique binaire.

Domaine de mesure	: ± 5 V
Impédance d'entrée	: 5 kΩ
Temps de codage	: 10 µs
Précision de mesure	: $\pm 5 \times 10^{-4}$ de l'échelle totale
Dérive du zéro	: ≤ 2 mV entre 0 et 40°C.

C. Les générateurs que l'on trouve dans cet ensemble sont constitués par des tiroirs de la gamme P 640, qui ont subi les modifications nécessaires pour les rendre programmables soit directement par des mots numériques (commutateurs de gammes), soit par les tensions analogiques délivrées par les tiroirs JDNA 10 (verniers).

On a deux voies principales de tiroirs générateurs et sur chacune d'elles il y a :

1 formeur programmable à temps de montée et de descente rapides ($t_m \approx 1$ ns, ± 5V/50Ω) : tiroir FIR 20P,

1 formeur programmable à temps de montée et de descente variables séparément (10 ns à 1 ms) : FIR 50P (± 10V/50Ω).

Chaque formeur d'une voie est déphasable par rapport au même formeur de l'autre voie, au moyen d'un déphaseur programmable type DP 10 P.

La fréquence de pilotage de ces tiroirs formeurs est assurée soit par le tiroir programmable PF 21 P, soit par un générateur synthétiseur programmable (Adret type CS 202) qui délivre une fréquence très stable (300 Hz à 60 MHz). Les sorties de ce dernier générateur peuvent être dirigées directement vers les appareils en essais.

En dehors des deux voies principales, on trouve également toute une gamme de générateurs spéciaux et programmables, utilisables dans les mesures du domaine nucléaire (GIA 30 P, générateur d'impulsions aléatoires rapides, FIP 40, formeurs physiques rapides programmables, PFTP 11, formeur de trains programmables, FIPF 40, générateur de temps morts programmables, ...). La liste de ces générateurs n'est pas limitative.

Dans le but de réaliser des mesures très précises en continu, et de tester les résistances de contacts du réseau de commutation à large bande au cours de leurs évolutions, il y a un générateur de tension programmable à haute définition (type Adret CV 102).

D. Le réseau de commutation programmable à très large bande a pour but de diriger les signaux disponibles sur les différentes sorties des générateurs vers les différentes entrées des appareils en essais.

Il y a deux canaux principaux. Sur chacun d'eux les signaux émis par les générateurs peuvent être acheminés sur des voies différentes :

soit sur deux voies à très large bande (temps de montée < 500 ps),

soit sur quatre voies un peu moins rapides ($t_m \approx 1$ ns),

soit une voie à temps de montée ≈ 3 ns.

Pour chaque canal il y a un atténuateur programmable de 1 000 MHz de bande passante. De plus, les signaux des deux canaux peuvent être rassemblés et mélangés sur une voie spéciale.

Ce réseau de commutation est réalisé avec des commutateurs coaxiaux programmables qui sont groupés dans trois châssis :

— 2 châssis CCATP 01 contenant chacun des commutateurs coaxiaux et un atténuateur programmable,
— 1 châssis CCRTP 01 contenant seulement des commutateurs coaxiaux montés en contact repos ou travail.

Chacun des châssis contient les alimentations de puissance des relais, les décodeurs logiques nécessaires et des montages générant des signaux de temps morts à chaque changement de configuration, pour éviter tout court-circuit par l'intermédiaire des commutateurs coaxiaux entre des sorties de deux générateurs différents.

E. Les appareils en essais peuvent être placés dans une étuve et alimentés par des générateurs de tensions, l'étuve et les générateurs étant programmables :

[220 V 500W; $\pm$6 V (1,5 A), $\pm$12V (1,2A), $\pm$24 V (0,7 A)].

Les valeurs extrêmes des tensions d'alimentation sont limitées quels que soient les programmes à des valeurs de $\pm$30% des valeurs nominales.

Les entrées des appareils en essais peuvent être connectées par programme à n'importe laquelle des voies du réseau de commutation. Il est donc possible d'y injecter tous les signaux des 'stimulus' nécessaires. Les sorties des appareils en essais peuvent être de même connectées par programme à n'importe lequel des appareils de mesures existant dans l'installation.

F. Parmi les appareils de mesures pouvant être simultanément utilisés dans cet ensemble, on trouve:

— 1 oscilloscope à échantillonnage programmable avec 2 voies d'entrée (Tektr. 568/230 et tiroirs 3S6, 3T6).
— 1 mesureur de temps de commutation programmable avec 4 voies d'entrées (extension à 10 possible) type EH 142 (résolution $\approx$ 50 picosecondes).
— 2 voltmètres à échantillonage rapides et programmables type EH 153.
— 3 compteurs fréquence mètres à sorties numériques et programmables.
— 1 voltmètre de précision à sortie numérique.

La liste des appareils de mesure n'est pas limitative et peut être facilement modifiée.

REFERENCES

1. **DUPUY, G.**, Tiroir distributeur de données numériques et analogiques JDNA 10. DEG/EI/R-2.806.
2. **DUPUY, G.**, Tiroir distributeur de données numériques JDN 10. DEG/EI/R-2.766.
3. **DUPUY, G.**, Tiroir convertisseur numérique-analogique JCNA 10. DEG/EI/R-2.768.
4. **LEFEVRE, R.**, **ROQUEFORT, H.**, Châssis alimentations C4/C6 ALJ 12 D avec Dataway. DEG/EI/R-2.494, 2.495.
5. **ROQUEFORT, H.**, Liaisons recommandées. Note CEA-N 1281.
6. Système d'instrumentation modulaire CAMAC. EUR 4100 f, mars 1969.

ESONE AND CAMAC NEWS

ESONE CHAIRMAN

Dr. Klaus D. MÜLLER of Kernforschungsanlage Jülich, Germany has agreed to his unanimous nomination by the ESONE Executive Group as ESONE Chairman for 1971-1972. This nomination will be considered by the ESONE Committee during the General Assembly at CEN, Saclay (October 5th-7th, 1971).

AMPLITUDE ANALOGUE SIGNALS

A preliminary issue of 'CAMAC—*Specification of Amplitude Analogue Signals*' has been authorised for issue by the ESONE Executive Group and is now available from the Secretary of the ESONE Committee. The document is subject to ratification at the General Assembly at CEN, Saclay (October 5th-7th, 1971) and if approved will be published as Euratom Report EUR 5100 in English (e), French (f), German (d) and Italian (i).

LIAISON

- ESONE members from CERN, Geneva, CEN, Saclay and AERE, Harwell were invited to the Sixth International Symposium on Nuclear Electronics (Warsaw, September 23rd-30th, 1971). The members from CERN, Mr. F. Iselin, and CEN, Mr. M. Sarquiz, presented communications on the CAMAC System.
- Representatives from AERE, Harwell, Mr. I. N. Hooton, Mr. A. Lewis, presented papers on CAMAC to an informal symposium at the Central Research Institute for Physics, Budapest, Hungary on June 14th-18th, 1971.
- Messrs. P. Christensen and P. Skaarup, representatives from Riso, Denmark, attended, as observers, the Dataway and Software Working Group Meetings in Vienna, June 7th-11th, 1971, and were welcomed as future members of these Groups.

(2)

ANALYSIS OF UNDERWATER SOUND RECORDINGS

by

D. N. MacLennan
MARINE LABORATORY, ABERDEEN, SCOTLAND

SUMMARY   A CAMAC-compatible system is described which interfaces an analogue tape recorder to a digital computer, and displays the computer output on a CRT. Under program control, sound recordings from a sea-bed hydrophone array are digitised by ADCs for the computation of power spectra and correlation functions. At the same time the position of an acoustic 'pinger' (pulse generator) relative to the array can be computed from measurements of pinger pulse arrival times at the hydrophones.

INTRODUCTION

Trawl gears (fish catching equipment) as used by fishermen today were mainly developed by the fisherman himself, using trial and error methods over a long period of time. Now, however, on account of the ever increasing worldwide demand for more efficient food production methods, fishery scientists are applying scientific principles to speed up the development of new fishing methods.

It has been known for some time that the catching power of a trawl gear is not necessarily proportional to its frontal area, that is to the rate at which it sieves water. This apparent contradiction is explained when it is realised that there is a fundamental distinction between fishing and (to take a homely example) straining tealeaves. In the former case, the fish may detect the presence of the fishing gear and react to it. Such behavioural responses will probably affect the catching power of the gear. Therefore, in order to understand the process of fish capture it is essential to take into account the behaviour of the fish as well as the mechanics of the gear. These two aspects are linked through the environmental disturbances caused by the gear, such as water-borne sound.

RECORDING TECHNIQUE

At the Marine Laboratory, Aberdeen, quantitative data on trawl noise are obtained by having a trawler tow its gear over an acoustic range, which consists of up to six hydrophones laid in an array on the sea-bed[1]. The hydrophones are connected by cable to a second ship, anchored nearby, on which the hydrophone signals are amplified as necessary and recorded on multitrack magnetic tape. In addition to picking up broad-band noise generated by the gear (1 Hz to 10 kHz is the frequency range of interest), the hydrophones also detect pulses from an acoustic 'pinger' attached to the gear. A measurement of pulse arrival times at three or more hydrophones can be used to calculate the position of the pinger (and, hence, the gear) relative to the hydrophone array. As the pinger pulses are modulated (modulation frequency 20kHz), the total frequency range which the recording must cover is 1 Hz to over 20 kHz. This is best accomplished by recording each hydrophone signal on two recorder tracks simultaneously. Direct recording (DR) on one track gives the bandwidth necessary for accurate pulse timing, while low frequency analogue signals are more faithfully recorded using frequency modulation (FM) on the second track.

For timing purposes, a reference frequency generated by a crystal controlled standard is recorded on a separate track.

ANALYSIS TECHNIQUE

The analysis instrumentation (Fig. 1) is based on the use of CAMAC-compatible modules for data transfer between a 14-track analogue tape recorder and a Marconi-Elliott 920C digital computer. The system is entirely controlled by computer program and has three distinct functions to perform:

1. Calculation of the position of the trawl gear relative to the hydrophone array (timing of pinger pulses);
2. Spectral or correlation analysis of recorded sounds (digitising of analogue signals);
3. Output of computed results for display on a CRT or as a permanent record on paper tape.

Currently available programs do not time-share between these functions, although more advanced software is now being developed. The amount of time-sharing which is practical is primarily a software limitation because CAMAC has provided a powerful and flexible hardware facility.

As drawn in Fig. 1, the analysis system processes signals from three of the hydrophones in the array. Signals from other hydrophones in the array may be subsequently processed by replaying the tape. Outputs from the three DR tracks are first filtered to reject broad-band noise, and then demodulated by a special purpose module in the CAMAC crate. Digital outputs from the demodulators are then applied to three of the inputs on an interrupt request register (7013), thus causing a LAM signal to be generated when a pinger pulse is detected on any track. The contents of this register determine which track (hence which hydrophone) originated the pulse. Meanwhile, a 100kHz waveform from the tape recorder reference frequency track is squared by a Schmitt trigger module and a level converter (7052) before being counted by one 32-bit section of a microscaler (type 003). Pulses from a clock pulse generator (7019) are counted in the second 32-bit section of the scaler to provide an alternative time reference which can be used to check tape recorder performance. By reading the microscaler, therefore, the program can access the tape running time as well as real time.

Outputs from the three FM tracks are first filtered to reject high frequencies, which could cause biasing, then the signals individually digitised by

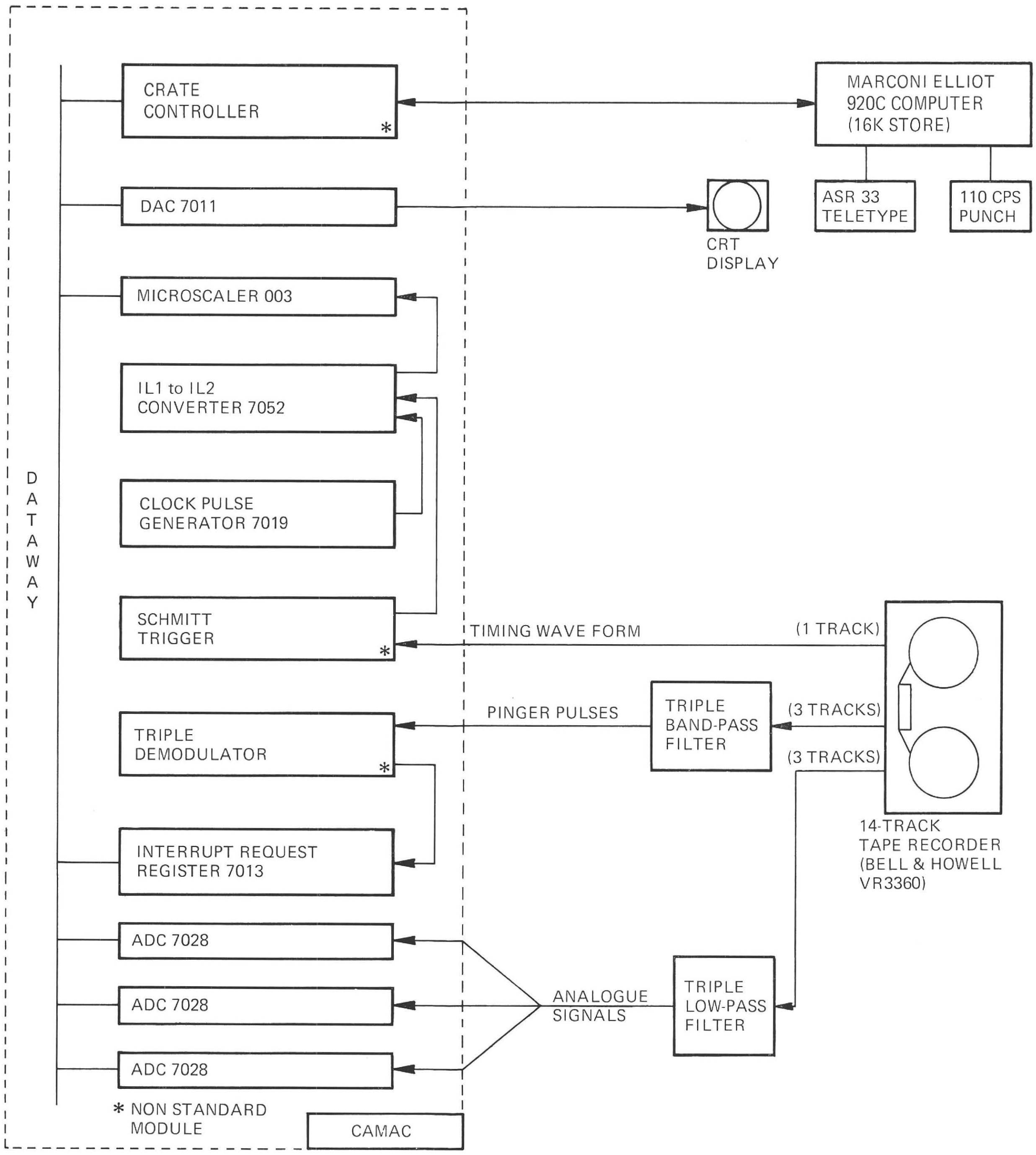


Fig. 1 Computer based sound recording analyser

separate A-to-D converters (7028). The relatively low cost of the 7028 makes it practical to use this approach, instead of the alternative method using an analogue multiplexer in front of a single ADC, which requires an additional control arrangement. Essentially, the CAMAC dataway has been used here as a digital multiplexer.

In spite of the intervening low-pass filter, the analogue signal applied to an ADC may be considerably affected when a pinger-pulse occurs on the corresponding tape recorder track, because the original acoustic pulse amplitude may have been large enough to overload the hydrophone amplifier system, so transferring some of the pulse energy to frequencies below the cut-off of the low-pass filter. The acoustic pulse amplitude will of course depend very much on the distance between the pinger and the receiving hydrophone. Due to reverberation and reflection of the pulse, spurious effects may last for some considerable time following reception of a pulse. Fig. 2 shows a typical pinger-pulse, as received by a sea-bed hydrophone 765 metres away from the pinger. In this case, the pulse length was 30ms and the hydrophone amplifier bandwidth 1 kHz to 50kHz. At such long range the pulse has not overloaded the amplifier and the subsequent disturbance of the trace, lasting for several hundred milliseconds, is clearly seen. To overcome this difficulty, it is necessary for the program to continue detecting the occurrence of pinger-pulses when carrying out spectral or correlation analysis. The program may then inhibit reading of the ACDs for a suitable period following each pulse, and so ensure that only undisturbed analogue data are sampled.

A D-to-A converter (7011) is provided in the system for the rapid output of computed spectra to a CRT display, by means of which short-term changes in the characteristics of recorded sounds may be observed. The computer can provide more precise numerical data directly to a fast paper-tape punch.

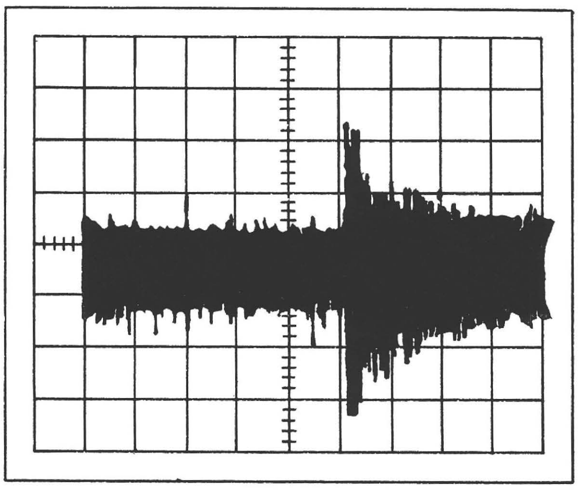


Fig. 2 Pinger pulse superimposed on sea state noise. Horizontal: 100 ms/cm. Vertical: 3.18 μbar (sound pressure)/cm.

The latter data are averaged results covering a period of 30 seconds or longer.

Diagnostic, warning and error messages are printed on a teletype (ASR 33), which is also used for operating control.

CONCLUSIONS

When designing equipment for use in research projects of the type described above, it is often necessary to take account of possible extensions to the basic experiment. A sufficient degree of flexibility must be included in the design so that equipment may be readily adapted as required. In such cases, the use of a CAMAC-compatible system provides the necessary flexibility for this purpose and reduces the engineering effort required to design and implement hardware systems for specific experiments.

REFERENCE

1. **MacLENNAN, D.N., HAWKINS, A.D.** 'The investigation of noise produced by fishing gear'. British Acoustical Society, Spring Meeting, University of Birmingham, April 1971.

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.*

LABORATORY ACTIVITIES

1

DESIGN CHARACTERISTICS FOR CAMAC MODULES

by

W. Heep, J.G. Ottes and K. Tradowsky

LABOR FÜR ELEKTRONIK UND MESSTECHNIK IM KERNFORSCHUNGSZENTRUM, KARLSRUHE, GERMANY

SUMMARY General rules for designing CAMAC modules are proposed: i.e., modules should have status and control registers at fixed sub-addresses; the generation and handling of the L signal should be standardised; in response to all valid commands the modules should generate the Q signal.*

These rules satisfy the CAMAC specifications and are intended to assist the design engineer. Acceptance of the rules would help to generate modules having a certain degree of common features which could ease software work.

INTRODUCTION

The specifications contained in EUR 4100 do not deal with design of CAMAC modules with the exception only of the Dataway port. These proposals concern general parts of each module [1,2]. They have been presented to the Dataway and Software Working Groups of the ESONE Committee and are under discussion. The proposals are made on the understanding that if, for example, a status register is needed then it should be put into a module according to certain guide lines.

* **Editor's Note:** This matter is under review by the ESONE Committee and the views expressed here are not necessarily those which may subsequently be adopted by the Committee.

STATUS REGISTER

All status information of the module is contained in its status register. The register has a maximum length of 24-bits and is allocated sub-address A (15). It can be read by A(15).F(1) and by A(15).F(0). The information of the status register could formally be sub-divided into two parts (Fig. 1):

1. Part 1 consists of important bits which can be staticized and masked. Changes of these bits lead to the generation of an L signal (leading edge, trailing edge or both).
2. Part 2 contains status bits which are not so important that changes in them must be signalled to the computer via an L signal. As these bits are supposed to change asynchronously with respect to Dataway operations, they are staticized on Read commands A(15).F(1) and A(15).F(0).

Changes of bits in Part 1 pass through an appropriate pulse forming network and an OR-gate and reach the set input of the LAM flip-flop. The L signal calls for a command reading the status register with A(15).F(1). On Strobe S2 of this read operation the LAM flip-flop is reset. Reading

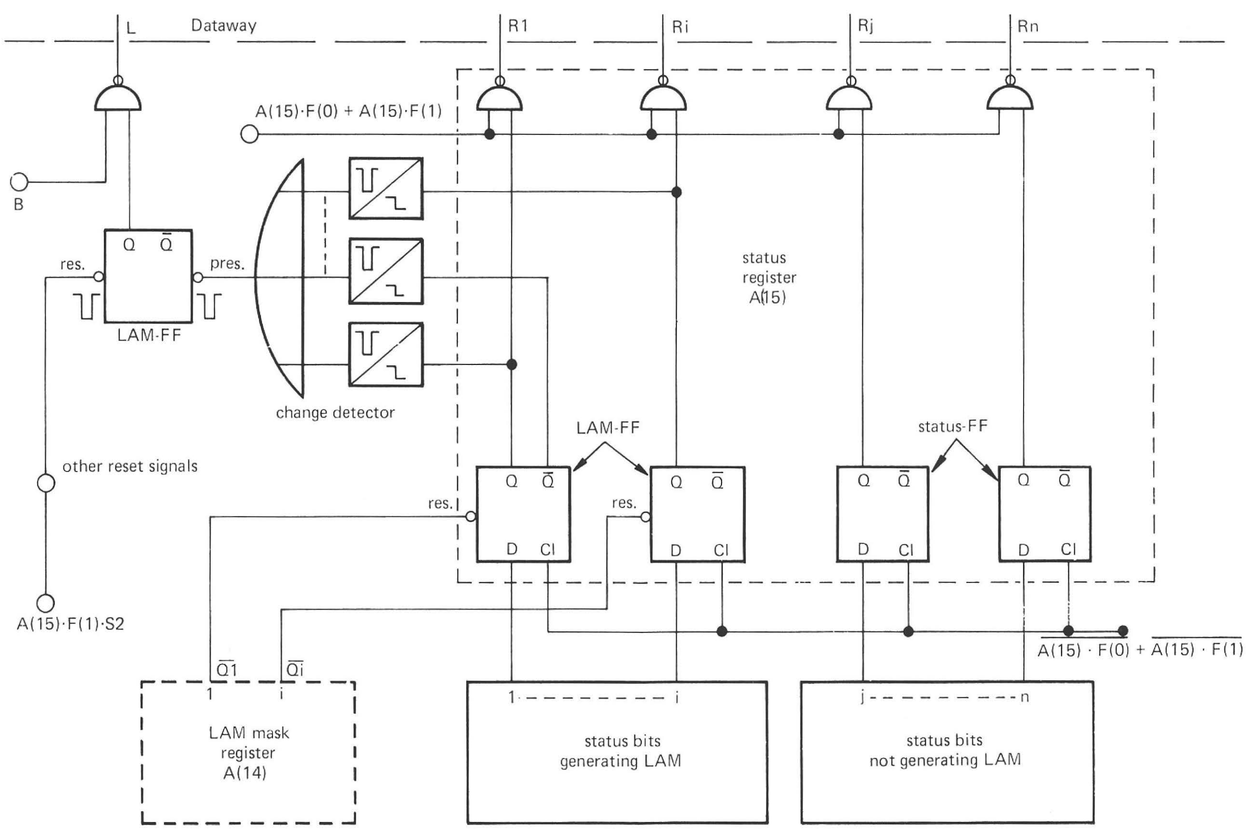


Fig. 1 Status Register A (15) and LAM-generation

the status register with function F(0) does not reset the LAM flip-flop. The status bits connected to the LAM-generating parts of the module can be regarded as the LAM sources which are to be reset by F(10). If the contents of a LAM source change while the status register is being read, this change produces an L signal only after the read command has terminated, thus following the Dataway specifications. This method of generating the L signal ensures that no L signal gets lost and none is serviced twice.

CONTROL REGISTER

The control register contains mask information and control bits (Fig. 2). Its maximum length should not exceed 24-bits. The sub-address is A(14). There are as many mask bits as there are LAM sources. The register can be read by function F(1) and written by functions F(17) and F(19). Function F(17) overwrites the control part of the register, F(19) overwrites the mask part of it. All mask bits are reset by the initialise signal I at the time of Strobe S2.

It is convenient to have a module enable/disable bit within the control register. It has no connection to the Dataway Write lines, but is operated with F(26)/F(24). The Z signal should disable the module. A disabled module does not make contact with the outside world, but remains connected to the Dataway and does not produce its L signal.

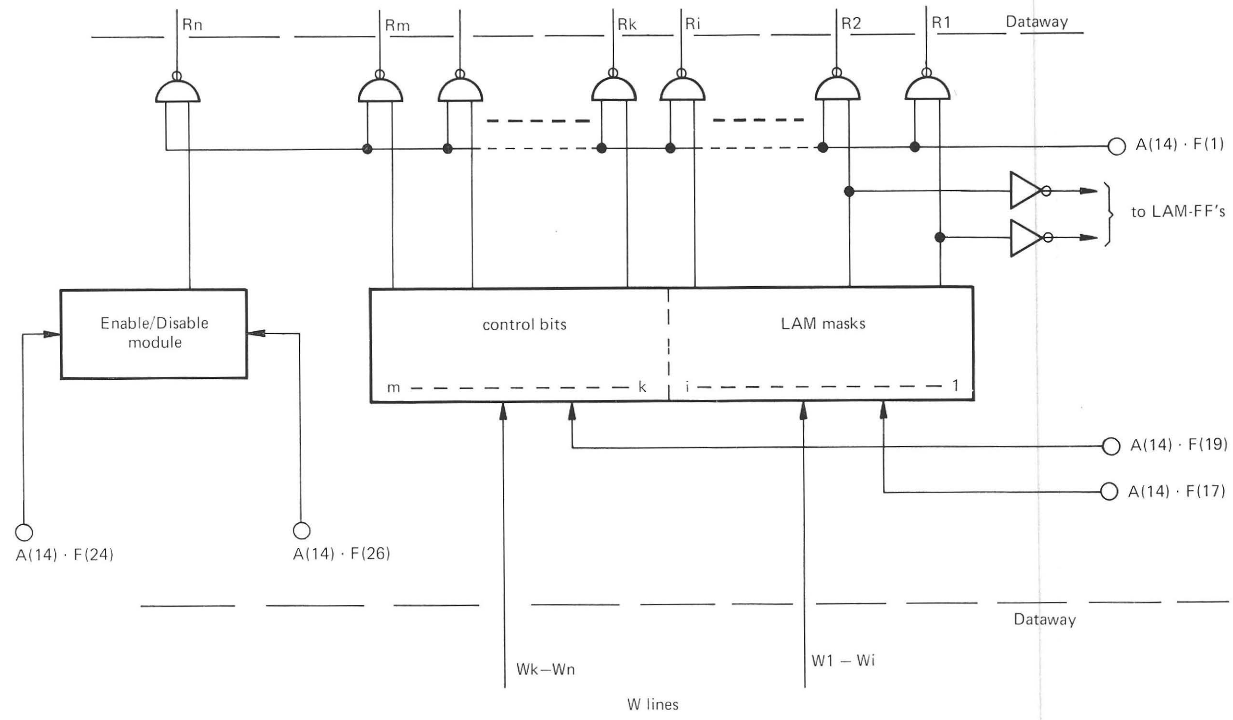


Fig. 2 Control Register A(14)

MODULE CHARACTERISTICS

This register contains information about the type of the module and is allocated sub-address A(13). Its capacity should be 12-bits minimum and 24-bits maximum. The user is free to wire it according to his own private 'module-recognition' code. Information is put on the Dataway Read lines on command A(13).F(1).

We believe that this register may not be as useful as was first thought to be the case. It will not contain, for example, vital information about the connection of the module to the external world and therefore reading the register will merely inform the computer that the right module has been placed in the right station—a fact already established by using a manual check list when installing the system. Furthermore, this register adds expense and occupies valuable space on the CAMAC card which might be used to better advantage.

REFERENCES

1. **HEEP, W., OTTES, J., TRADOWSKY, K.** Konzept für Entwurf und Spezifizierung von CAMAC-Modulen. Kernforschungszentrum Karlsruhe, Externer Bericht 22/71-6, 1971.
2. **HEEP, W., OTTES, J., TRADOWSKY, K.** Alarm-Verarbeitung und autonomer Datentransfer im CAMAC-System. Kernforschungszentrum Karlsruhe, Externer Bericht 22/71-7, 1971.

2

A VERSATILE PDP-11 CAMAC CRATE CONTROLLER FOR NUCLEAR DATA ACQUISITION AND PROCESSING

by

H. Halling, K. Zwoll, K.D. Müller

KFA JÜLICH, ZENTRALLABOR FÜR ELEKTRONIK, GERMANY

SUMMARY A crate system controller has been designed to offer an economical and simple interface between the CAMAC dataway[1] and unibus of the PDP-11[2]. This unit has the capability of transferring commands as well as 16 or 24 bit data words between the computer and a single module in programmed, increment to memory, add to memory, block and scan transfer modes. An interrupt vector-generator module provides fast LAM handling. To provide a versatile system the software for controlling the interface was kept simple and powerful.

DESCRIPTION

The crate controller acts as a single peripheral device connected to the unibus. The CAMAC branch highway[3] has not been used because of the analogous asynchronous timing of the unibus which offers similar advantages except multi-addressing. The unibus address lines are used to address the controller registers as well as the CAMAC registers inside the crate directly, thereby providing the C, N, A information.

Registers of the controller are addressed by N(24) whose occurrence disables the generation of the CAMAC timing cycle. 512 external addresses are needed for each crate, allowing up to two crates in a system if the DEC reserved extended addresses are used. When the addresses of a 4k memory extension block are used, up to eight crates can be added.

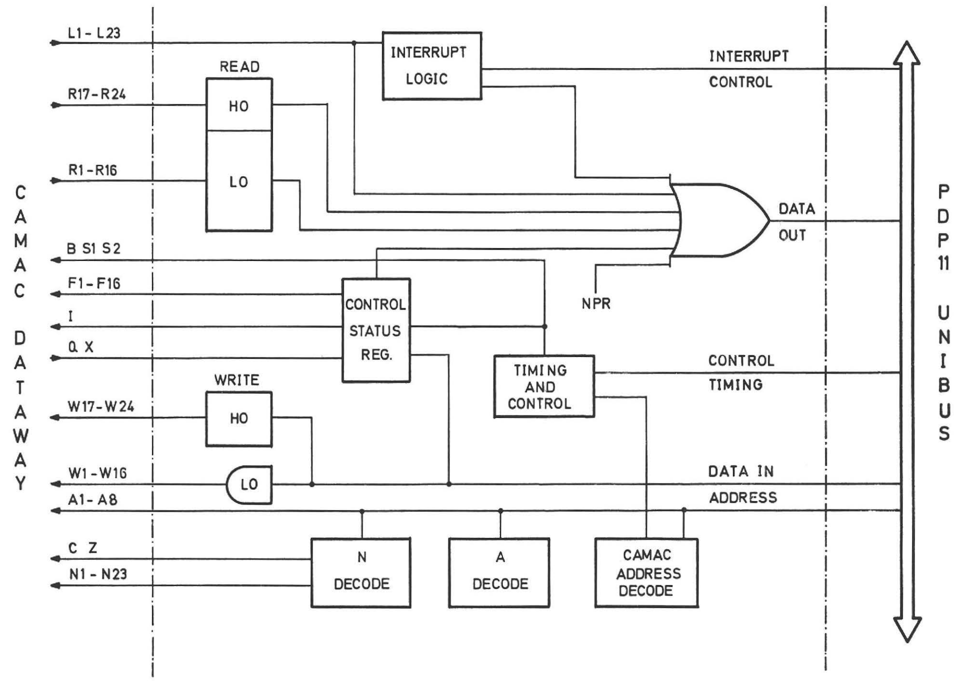


Fig. 1 Crate system controller (CSC 11) block diagram

The system consists of three sub-units:

(1) A basic double-width CAMAC crate system controller for programmed transfer,
(2) A single-width LAM sorter for interrupt vector generation,
(3) A single-width nonprocessor interrupt CAMAC module (NPR) for increment, add-to-memory and block transfer.

1. The first unit is connected to the unibus directly and delivers the required unibus signals via connectors to the other optional modules.

Four basic functions are performed by the computer via the crate system controller in programmed data transfer mode:

(a) Commands to the controller itself (e.g. bus statements for the crate; clear; initialize; inhibit; preparation commands to the control status register, etc.),
(b) Commands for CAMAC actions without data (mode 0). (e.g. module enable, test Q, etc.),
(c) PDP-11 commands handling 16 bits between computer and CAMAC registers (mode 1),
(d) Read or write 16 or 24 bits of data from or to addressed CAMAC registers (mode 2).

Fig. 1 shows the block diagram of the unit. The central control status register determines the state of the controller. It contains the five function bits (F), two mode bits, bits for interrupt enable-disable, inhibit set-reset, WC-state, overflow, DMA on-off, Q and X response, Q enable-disable, and short CAMAC cycle (700 ns without S2) on-off.

The internal functions of the controller are controlled by N(24) and the decoded A_i. The CAMAC timing cycle is started only when $N<24$ and delivers the asynchronous answer slave syn. at the end of the CAMAC-busy.

An eight bit latch register for 24 bits WRITE stores eight bits high order data until the CAMAC cycle is started. For READ operations, latches are used to store the 24 bits read-information because of the CAMAC READ-and-CLEAR command (data set to 0 by S2). In addition to the READ data, the 23 LAM lines, the control status register as well as information from the NPR unit are transferred via the unibus datalines.

All crate system controller registers are overwritten by a single PDP-11 instruction. The CAMAC registers are addressed in three modes which are changed by preparation instructions (one computer instruction):

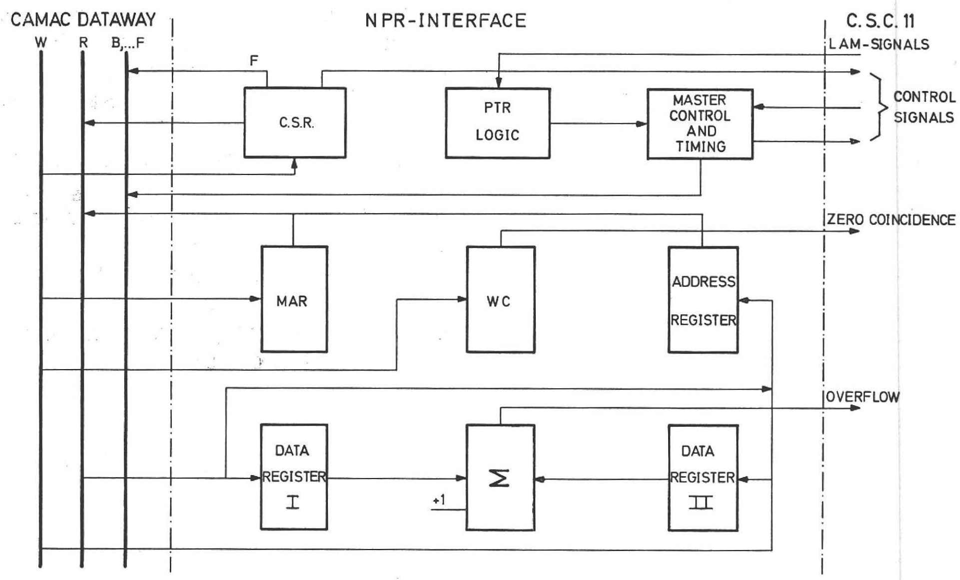


Fig. 2 Block diagram of the NPR interface module

(a) Mode 0 means CAMAC actions (one computer instruction).

(b) Mode 1 means PDP-11 mode and handles CAMAC registers like memory registers (16 bits only).

(c) Mode 2 means 24 bits READ, WRITE and therefore needs two computer instructions.

2. The interrupt handling is the same as in available DEC modules where the controller delivers one vector per crate. The number of vectors is increased up to 23 by an optional single-width CAMAC LAM-sorter.

3. A single -width nonprocessor interrupt CAMAC module for increment memory, add-to-memory and block transfer completes the system (NPR). This unit allows 2 CAMAC modules (e.g. ADC input registers) to have direct memory access to the PDP-11. It is connected to the modules and the CSC-11 via the CAMAC dataway except for some control signals which are wired via front panel cables. If more NPR interfaces are needed, one can use additional NPR-Modules.

Fig. 2 shows the block diagram with memory address register (MAR), wordcount register (WC) and control status register (CSR) with mode bits, CAMAC function F and control bits. One 16-bit full adder is used for increment and add-to-memory mode. The address register is used for temporary storage of the address information. The circuit is activated by the appropriate L signal. It becomes bus master using the priority transfer control circuit and then the transfer takes place starting with a Dataway timing cycle. The read information is used in the following modes:

(a) Increment content of memory where the information generates the address.

(b) Write into memory locations or read memory locations in incremental address order (constant CAMAC address).

(c) Add to appropriate memory contents.

This modular and flexible concept which is designed for a 'small' CAMAC system provides all normal pulse height analyzer functions (PHA) in a simple and economical way.

REFERENCES

1. 'CAMAC—A Modular Instrumentation System for Data Handling', EURATOM Report EUR 4100 e, March 1969.
2. PDP-11 UNIBUS Interface Manual, 2nd Edition.
3. CAMAC—Organization of Multi-Crate Systems, EUR 4600 e (to be published).

3

A CAMAC OPERATING SYSTEM FOR CONTROL APPLICATIONS

by

B. Mertens

INSTITUT FÜR KERNPHYSIK DER KFA JÜLICH, GERMANY

SUMMARY   A simple CAMAC operating system has been developed using FORTRAN to a large extent. This software allows the handling of the CAMAC control system associated with the Jülich Isosynchronous Cyclotron on the basis of a symbolic language. Additional features include three levels of different priority, definitions of symbolic programs in real time and assignment of these programs to the different levels in real time. Great emphasis has been placed on reliability and error detection.

INTRODUCTION

The software system described here was developed for the control of the variable-energy isochronous cyclotron at Jülich. The control of such a machine involves approximately 100 analog and 100 digital parameters.[1] It was considered that this could be done most advantageously by making use of a computer (PDP-15/20 extended version[2]) and CAMAC hardware. The software should provide high flexibility to meet changing requirements in real time. It should also guarantee ease of error detection and high reliability. Devices which require fast computer response (less than 20 ms) were not intended to be serviced by this operating system. If there is a need for such devices, their service routines will be directly connected to the CAMAC interrupt handler.

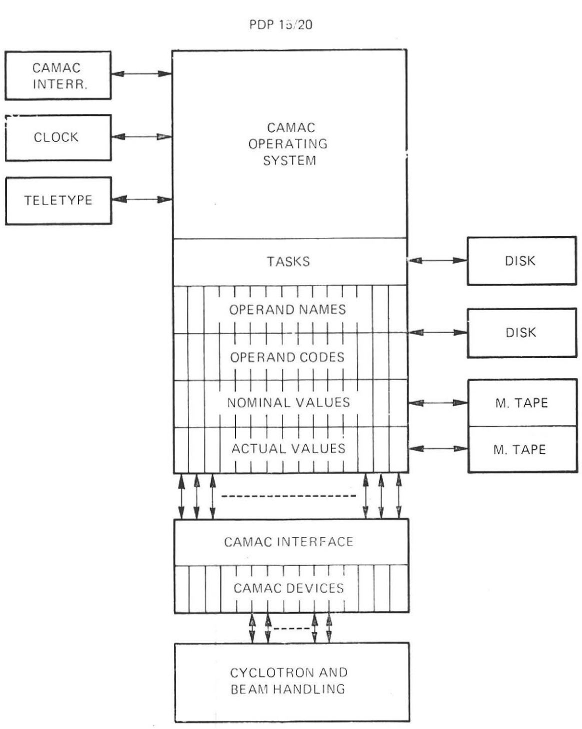


Fig. 1 Scheme of the hardware and software of the cyclotron control system

SYSTEM PHILOSPHY

Fig. 1 gives the block diagram of the structure of the operating system. A user-defined sequence of CAMAC and other symbolic commands (called 'task' from here on) may be started by one of three sources: an interrupt from the CAMAC system, the real-time clock reaching a certain preset time, or an input from the console typewriter (Teletype). A Teletype initiated task may be interrupted by tasks started by CAMAC or the real-time clock on completion of the last command. CAMAC may also interrupt clock-initiated tasks. Thus one has three levels of operations with different priorities.

Every CAMAC device or sub-device (OPERAND) represented by a certain CNA (crate address, station number, subaddress) is associated with a symbolic name (OPERAND NAME) and with an OPERAND CODE containing the CNA. These may be redefined in real time. The operating system accommodates 200 OPERANDs. Two additional core-storage locations belong to each OPERAND, containing the NOMINAL and ACTUAL VALUE of the OPERAND. Blocks of the 200 NOMINAL or ACTUAL VALUES may be written into, or read from, mass storage devices by symbolic commands which attach a freely selectable file-name to the block. The different tasks are stored on a fixed-head disk. They are automatically loaded into core upon request.

COMMAND STRUCTURE

Fig. 2 shows the principle of command coding and decoding. The symbolic command entered from the Teletype may consist of up to three 'names' or two 'names' and one number. A 'name' begins with an alpha-character and ends with a separator (blank or equal sign). Only the first five characters are significant. If no name is being processed a number may begin, and that with a numeral, with or without a minus sign. It ends with the first non-numeral which is not a decimal point.

The first name must be a FUNCTION NAME, the other components being optional. Legal commands are for instance:

IDIS(disable CAMAC interrupts)
WRITE MODUL(set 'MODUL' to nominal value)
WRITE DEV12 = 3.45(set device 'DEV12' to 3.45)
DTOUT ACTUAL.VALUES = FNAME(write all actual values onto tape as file 'FNAME').

The commands are coded into three computer words. If a task is being defined, they are written onto mass storage (disk). If a task is called, they are read from the external storage into core. When the command has to be executed the three words are decoded into the FUNCTION CODE, OPERAND CODE, and PARAMETER. The three bits called PARAMETER TYPE determine what has to be taken as parameter e.g. none, a 24 bit number (binary or bcd), the actual value of OPERAND number INDEX 1, the nominal value of OPERAND number INDEX 2, or a 5-character file-name. FUNCTION and OPERAND CODE and PARAMETER are directly comprehensible by the executive part of the operating system.

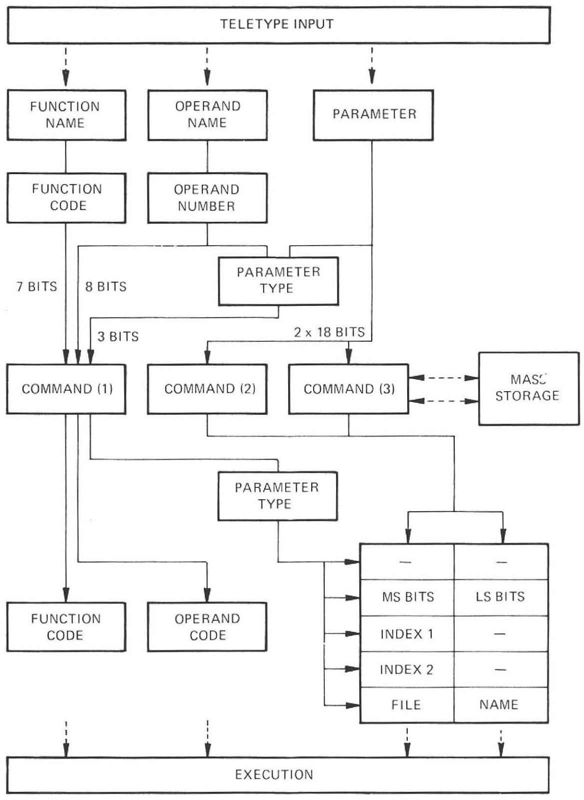


Fig. 2 Structure of the command coding and decoding in the CAMAC Operating System

CONCLUSIONS

Since the CAMAC Operating System was programmed mainly in FORTAN it is apparent that it can be easily applied to other computers which have System Operating Software. Another feature is that special functions may be simply appended to the CAMAC Operating System by adding a FORTRAN sub-routine which is comptatible with the definitions given above. Core storage locations may be saved by replacing FORTRAN routines by others written in assembler language, or by making use of an overlay technique.

Although the CAMAC Operating System was written for cyclotron control, it seems to be suitable for other complex CAMAC driven control systems which require high flexibility and reaction times which are not too short.

REFERENCES

1. **KALTENBACH, V., KUHLMANN, W., MERTENS B.** Geplante Rechner-Steuerung des Isochronzyklotrons in Jülich über ein CAMAC-Interface. A paper read at the session of the "Studiengruppe Nucleare Electronik", Würzburg, 21-23 Sept. 1970.
2. A product of Digital Equipment Corporation Maynard, Massachusetts, USA.

4

AN APPROACH TO A CAMAC LANGUAGE

by

M. Sarquiz, P. Valois

CENTRE D'ÉTUDES NUCLÉAIRES DE SACLAY, FRANCE

SUMMARY The CAMAC software facilities being developed at SACLAY are described. Although this approach demonstrates some discrepancies and is possibly more restrictive than the approach being made by the ESONE Software Working Group, the work is considered valuable as a 'bootstrap' to test users' reactions.

INTRODUCTION

The paper gives a short presentation of the CAMAC software facilities being developed at Saclay. The objectives are as follows:

1. to have a set of CAMAC macro-instructions usable in Autumn 1971 running on a TELEMECANIQUE T2000 computer (19-bits, 8 k),
2. to help programmers in handling CAMAC exchanges or to write operating systems,
3. to obtain execution duration not significantly longer than with direct assembly programs,
4. to provide the possibility of mixing assembly language (machine language) and CAMAC instructions.

This last topic can easily be obtained by ignoring, as a first step, assembly instructions and translating CAMAC sentences into assembly instructions, the resulting text then being used by the standard assembler of the machine.

CAMAC INSTRUCTIONS

A CAMAC program is divided in two successive parts:

1. CAMAC device declarations giving the arrangements and addresses of the used devices.
2. CAMAC and/or assembly instructions.

Each instruction is closed by (;), and (/) is the starting point of a CAMAC statement. The following lines show some examples of the possibilities of this CAMAC language rather than an exact description of it.

DEVICE DECLARATION

To avoid any possible confusion between users sharing the same branches or the same crates and to introduce a minimum order, branches, crates and devices must be explicitly declared and only symbolic references are allowed in the CAMAC statements.

Branch declaration

The general form is:

/ BR α = h, ..., BR γ = k;

where BR α, γ, etc. refer to the branch names, h, k, etc. refer to the branch numbers.

EXAMPLE

/ BR 1 = 3, BR 2 = 1;

Each time the symbol BR 1 is encountered in the program it specifies the CAMAC Branch number three.

Crate declaration

The general form is:

/ CRAT A = BR α/b,..., CRAT G = BR γ / g;
where CRAT A, B, etc. refer to the crate names.

EXAMPLE

Assuming branch declaration above:

/ CRAT 1 = BR 1/5, CRAT 2 = BR 2/3;

means that CRAT 1 is the fifth crate of branch number three and that CRAT 2 is the third crate of branch number one.

Device declaration

A device can be an array of elements or an isolated one. An isolated one is defined by its branch number, crate number, station number and sub-address. The general form for the declaration of an isolated device is:

/ Name (CRAT X, N, SA);

where Name refers to the device name.
N refers to the station address.
SA refers to the sub-address.

EXAMPLE

Assuming the branch and crate declarations above:

/ SCAL (CRAT 1, 5, 3);

means that the device named SCAL is in branch number 3, crate number 5, station address 5, and sub-address 3.

The general form of an array of elements is:

/ ARRAY (CRAT X, Nb: Ne: I, SAb: SAe: J);

where: ARRAY is the name,
subscripts b and e refer to the beginning and end of the station addresses and sub-addresses. I and J refer to increments used to explore the set of N and SA.

An array can be defined by omitting optional designations as I or J (increment ≑ 1). If Ne and SAe are omitted as well as I and J, the array is reduced to an isolated element.

EXAMPLE

Assuming branch declaration and crate declaration above, the following declaration:

/ SCALARRAY (CRAT 1, 5 : 9 : 2,0 : 3 : 1);

means that a set of devices located at:

Branch number	3		
Crate number	5		
Address	5	sub-address	0 1 2 3
	7	" "	0 1 2 3
	9	" "	0 1 2 3

has to be handled by the CAMAC function as an entity.

For the T2000 computer, a 12-word memory zone would be reserved with the CNA field built in according to the hardware specifications.

Alternatively, it is possible to apply an executable statement (CAMAC function) to a device of an array previously defined by using the following address forms:

/ Function SCALARRAY (X);

which means that the function is applied to the (X+1)th element of SCALARRAY according to the value of the index register during the program execution.

EXAMPLE

/ READ 1 SCALARRAY (3);

means, assuming the declaration above, read the 4th element of SCALARRAY, i.e., read the device at station address 5, sub-address 3 in Crate 5 of Branch 3.

Note that in these declarations the components of an array necessarily belong to the same crate and branch.

For a global handling of a subset of an array it is necessary to specify another declaration, for example, if we have to handle in SCALARRAY the devices whose sub-address is 2, it is necessary to state:

/ SCALBIS (CRAT 1,5: 9: 2,2);

and the consequent loss of memory location is compensated by an increase in speed of execution. Again note that with this method of declaration:

(1) a device qualifies a crate and a branch,
(2) a crate qualifies a branch.

EXECUTABLE STATEMENTS

In these statements the CAMAC functions are classified in the four following groups:

(1) functions transferring DATA except those loading multi-addressing-registers,
(2) test functions,
(3) command functions,
(4) functions loading multi-addressing-registers.

The relationship between this classification and the CAMAC function codes is given in table 1 together with the symbolic names of these functions.

Data transfer functions

EXAMPLE:

An example is the best illustration:

/ LECGB1 *long** SCALARRAY BETA

IF Q = 0 Goto LABEL;

The elements in italics are optional. This statement produces the set of assembly instructions sending the CNAF values to the CAMAC coupler (within a loop if SCALARRAY is an array device), transferring the data in a core memory word or zone, and the test and jump instructions according to the Q value.

(long) means: full CAMAC information transfer. If this element is not present 18 bits of information data are allowed.

If Q test is not used, Q value is ignored.

/ READ 1 SCALARRAY (X) BETA;

If SCALARRAY is an array device only one CAMAC register is read according to the current value of the core index register. An error is sent at compile phase if the device is not an array.

* means: multi-addressed operation.

TABLE 1 PRINCIPAL CAMAC COMMANDS

	CAMAC	SYMBOLIC	PURPOSE
DATA TRANSFER FUNCTIONS	F(0)	LECGR 1	Read Group 1 Register
	F(0)	LECAPC	Read pattern of crate call
	F(0)	LECAPS	Read pattern of branch call
	F(1)	LECGR 2	Read Group 2 Register
	F(2)	LECRAZ	Read and set to 0 Group 1 Register
	F(16)	ECRGR 1	Write Group 1 Register
	F(17)	ECRGR 2	Write Group 2 Register
	F(18)	OCRGR 1	Selective Overwrite Group 1 Register
	F(19)	OCRGR 2	Selective Overwrite Group 2 Register
TEST FUNCTIONS	F(8)	TESTAP	Test a Device Look-at-Me
	F(10)	TESRAP	Test and Reset a Device Look-at-Me
	F(27)	TESETA	Test a Device Status Register
	F(27)	BRPERM	Test if Branch Enable
	F(27)	TESAPB	Test a Branch Look-at-Me
	F(27)	ITEST	Test if Crate Disable
COMMAND FUNCTIONS	F(9)	RAZ 1	Set to 0 Group 1 Register
	F(11)	RAZ 2	Set to 0 Group 2 Register
	F(24)	MISHOR	Disable a Device
	F(24)	HSBR	Disable a Branch
	F(24)	DCHOR	Disable a Crate
	F(25)	IMCREM	Increment Register
	F(26)	MISEN	Enable a Device
	F(26)	VALBR	Enable a Branch
	F(26)	DCVAL	Enable a Crate
FUNCTIONS LOADING MULTI ADDRESSING REGISTERS	F(16)	ECRSNR	Write Multi-address Register
	F(16)	ECRRAC	Write Multi-crate Register
	F(16)	ECRRAB	Write Multi-branch Registe

Test functions

They provide conditional jumps without loading core memory words.

EXAMPLE

/ IF TESAPB BR 1 = 0 Goto L1;

means if there is no call from the third CAMAC branch then an unconditional jump to the L1 labelled statement is implied.

The complementary test can be used:

/ IF TESAPB BR 1 / = 0 Goto L1;

Command statements

A command statement does not imply either a test or a data transfer even if it modifies the internal value of a CAMAC Status or register. The statement is as follows:

/⟨Command Function⟩ ⟨*CAMAC Reference*⟩;

EXAMPLE

/ RAZ 1 SCALARRAY (5);

requires the action of setting to 0 the Group 1 register at the branch number 3, crate number 5, station address number 7, and sub-address number 1, assuming the earlier declaration of SCALARRAY.

Multi-addressing register load

As some functions allow multi-addressing exchanges, the facility of preparing and loading the CAMAC register is provided.

EXAMPLE

/ ECR SNR SCALARRAY (0), SCALARRAY (4);

This causes the SNR register of the Branch number 3, crate 5 to be loaded with a pattern corresponding to the 5th and 7th station addresses, sub-address 0.

CONCLUSION

This method of defining a CAMAC language has the advantage of relative simplicity and we expect that an implementation of such a language on a computer needs less than three months of a well-trained programmer.

Another important point is that the execution time for a CAMAC Command is, in general, the same as if a direct assembly program is used. In worst case conditions, only one or two assembly instructions are added.

This set of CAMAC instructions cannot be considered as complete and we expect that it will be possible after getting back the results of users' experience to be able to define some complementary instructions or facilities (to initialise users' experiments, for example).

This work is not system orientated and consequently the automatic handling of interrupt is avoided. Our feeling is that it is difficult to solve such a problem in its generality without an inadmissible loss of speed, performance and core memory space.

However, it is possible with the set of statements that we are developing to assist in writing programs for systems adapted to peculiar configurations.

5

AN UNCOMPLICATED MODULE-CHARACTERISTIC FOR A CAMAC MODULE

by

H. Loevenich, E. Pofahl, H. Halling, K. Zwoll

KFA JÜLICH, ZENTRALLABOR FÜR ELEKTRONIK, GERMANY

Stepping motors used at the Triple Axis Neutron Spectrometer HADAS[1] are controlled by CAMAC control modules. Speed torque relation of the mechanical system requires an individual frequency response for every type of stepping motor. Thus the control modules are not interchangeable. To avoid malfunction by wrong positioning or change of the modules in the crate a Module-Characteristic is built in. This characteristic is implemented by relating fixed wired numbers to each module. These numbers can be read as content of Group 1 register, sub-address A(14).

All programs controlling the motors comprise two parts, namely a positioning program, which is written with variable addresses Ni[2] (i corresponding to the characteristic number) and an establishing program (group 29 and 30 in table 1). This program reads all module characteristics with Ni. A(14) (i = 1 to 23) and assigns the correct addresses to the individual control modules. Hence changing the module positions in the crate has no influence on correct program execution if the establishing part of the program is run first.

REFERENCES

1. **ZWOLL, K., SCHMIDT, H.H., MÜLLER, K.D.** 'A Computer controlled Triple-axis Neutron Spectrometer with CAMAC Instrumentation'. KFA JÜL-Report: JÜL-744-ZE-FF, Juni 1971.
2. **MAY, F., HALLING, H., PETRECZEK, K.** 'Focal Overlay for CAMAC Data and Command Handling'. CAMAC Bulletin, No. 1, June 1971.

TABLE 1 :

```
C-FOCAL, 1969

01.01 A !"DRIVE TO ZERO=0 FROM CURRENT ANGLE=1", J, !;
01.02 I (0.5-J)3.1;
01.05 * 2, 1;S WR=0;S WS=0;
01.10 * 7, 1, N1, 0, 17, 1, 0;* 7, 1, N2, 0, 17, 1, 0
01.15 F J=1, 4;* 0, 1, N1, J, 10;* 0, 1, N2, J, 10;
01.20 * 0, 1, N1, 7, 26;* 0, 1, N2, 7, 26;
01.21 * 0, 1, N1, 4, 8, Q;S T1=Q;* 0, 1, N2, 4, 8, Q;S T2=Q;
01.22 I [(T1+T2)-1.5]1.2;
01.24 * 6, 1, N1, 0, 0, 1, WA;
...................................................
...................................................
..................PROGRAM..........................
...................................................
...................................................
29.01 FOR N=1, 23;DO 30
29.10 GOTO 1.01

30.10 * 6, 1, N, 14, 0, 1, A;          /READ MODULE-CHARACTERISTIC
30.15 IF (1-A)30.2, 30.3, 30.4;       /CHECK NUMBER
30.20 S N2=N;R                        /SET N2
30.30 S N1=N;R                        /SET N1
30.40 R                               /NO STEPPERCONTROLLER
```

ACTIVITIES OF THE ESONE WORKING GROUPS

The ESONE Committee has authorised four working groups to investigate specific aspects of CAMAC. The current programmes of work of these groups were described in CAMAC Bulletin No. 1, pages 27 and 28. Recent activities, between March and August 1971, are reported below.

Analogue Signal Working Group

Chairman: Dr. K. Tradowsky, GFK, Karlsruhe.

This working group recommends standards for analogue signals used on front-panel connections to CAMAC units. A preliminary version of the 'Specification of Amplitude Analogue Signals' was issued in February 1971 with the authority of the Executive Group, but will be subject to ratification by the General Assembly in October, 1971.

Dataway Working Group

Chairman: Mr. H. Klessmann, HMI, Berlin.

This working group recommends standards for digital interconnections via the Dataway, Branch Highway, and front-panel connectors. It has met recently in March at RHEL, England, and in June at SGAE, Vienna. The USAEC NIM Committee was represented at these meetings by Mr. F.A. Kirsten (Chairman, US CAMAC Dataway Working Group) and by Mr. S.J. Rudnick and Mr. L. Biswell.

The preliminary issue of the 'Specification of the Branch Highway and CAMAC Crate Controller Type A' has been translated into French and German. The final version, which will be published as EUR 4600 e, has been prepared for printing. The use of presently reserved lines in the Branch Highway for controlling multi-controller multi-branch systems has been discussed but no recommendations have been made.

This working group, in close collaboration with its NIM counterpart, is preparing a revised issue of the CAMAC Specification EUR 4100. Firm recommendations have been made on the more important points. The aims are to define some aspects of CAMAC more precisely, to improve the presentation and explanation of others, and to make only such changes as are compatible with existing equipment.

Mechanics Working Group

Chairman: Mr. F.H. Hale, AERE, Harwell.

This working group recommends the mechanical constructional standards of CAMAC crates and plug-in units, for publication in EUR 4100. The group met in March at CEN, Saclay, and again in June at AERE, Harwell. The chairman of the US CAMAC Mechanics and Power Supplies Working Group, Mr. D.A. Mack, was present at the latter meeting.

The group is preparing recommendations for the revision of the relevant parts of EUR 4100. Like the Dataway Working Group, it is aiming to improve the definition and presentation of the standards, and to ensure that any necessary changes are compatible with existing equipment.

Software Working Group

Chairman: Mr. I.N. Hooton, AERE, Harwell.

The Software Working Group has now agreed on a proposal for a first CAMAC language. This will provide concise statements for controlling CAMAC systems. It must be used in conjunction with a more conventional programming language, which will provide the algorithmic statements of a complete program. It is hoped to present the definition of this language to the General Assembly in October.

The definition includes suggestions for an implementation technique. As an aid to this, the Group is now considering a standard intermediate language which should enable the implementation to be broken down into two independent parts. The first part can be largely installation independent, analysing the source language statements and producing an output in the standard intermediate form. The second part is then used to convert the intermediate form to one suitable for running in a particular environment of computer and system controller.

ESONE AND CAMAC NEWS

ESONE-NIM COLLABORATION

The NIM-CAMAC Dataway and Software Working Groups met at LAMPF, Los Alamos, New Mexico on April 27th-29th, 1971, and the Chairman of the ESONE Software Working Group (Mr. I.N. Hooton, Harwell) attended as the official ESONE Representative.

Two American colleagues (Mr. L. Biswell, LASL and Mr. S. Rudnick, ANL) participated in the ESONE-CAMAC Dataway and Software Working Group Meetings at SGAE in Vienna, June 7th-11th, 1971.

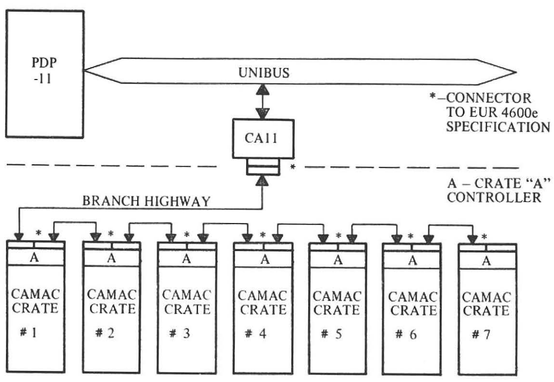
Mr. D. Mack of LRL, Berkeley, attended the ESONE-CAMAC Mechanics Working Group Meeting at Harwell, June 29th-30th, 1971, as the official NIM Representative and on this trip to Europe visited the Harwell, Saclay and CERN Laboratories.

NEW PRODUCTS

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

PDP-11 CAMAC Interface Model CA 11-A

The basic PDP-11 CAMAC Interface provides a CAMAC Branch Highway controller conforming to the EUR 4600 e ESONE specification. The power of the PDP-11 I/O structure has been extended deep into the CAMAC crate. Data transfer is via the programmed I/O of the PDP-11.



After the CAMAC function has been selected using one PDP-11 instruction, each 16-bit data transfer can be effected in one PDP-11 instruction; each 24-bit transfer in two PDP-11 instructions. A CAMAC crate device (defined by sub-station address) is addressed as directly as any standard peripheral. Each of the 24 graded-L outputs has its own specific vector address on the PDP-11 unibus. Interrupts cause breaks directly to the service routine for the particular CAMAC module. These features alleviate the necessity to have an expensive direct memory access controller.

PROGRAMMING SEQUENCE FOR DATA TRANSFER :

Write to CAMAC:

(1) Transfer the Function and crate address to the branch driver.
(2) * Transfer the most significant 8 data bits.
(3) Transfer the least significant 16 data bits (this instruction effects data transfer to the CAMAC device).
(4) Repeat Step 3 or
Repeat Steps 2 and 3 (24-bit transfers) or
Repeat Steps 1 and 3 (for a new Function).

Read from CAMAC:

(1) Transfer the Function and crate address to branch driver.
(2) Transfer the least significant 16 bits to PDP-11. (This instruction effects data from CAMAC device).
(3) * Transfer the most significant 8 data bits.
(4) Repeat Step 2 or
Repeat Steps 2 and 3 (24-bit transfers) or
Repeat Steps 1 and 2 (for a new Function)

No. of Systems Units: 1 M-Series Module

Ref. Digital Equipment Corp.

* This instruction can be omitted if only 16-bit transfers are required.

OTHER SYSTEM UNITS (not related to Branch highway or Dataway)

Store Interface 7067

This unit finds applications in association with the Programmed Dataway Controller 7025 which is a controller having properties not dissimilar from a computer's CPU (Program Counter, Instruction Address Register and 24-bit Accumulator). The program of instructions for execution by the 7025 can be held in magnetic core stores interfaced to CAMAC via the 7067. Four magnetic core stores each with 1024 bytes of 8-bits can be coupled to the 7067, and byte organisation within the 7067 locates each 24-bit word into three successive store locations. A 7025 system incorporating a 7067 may have access, therefore, to 341, 682, 1024 or 1365 words of active memory for program or data storage.

The 7067 extends the 8-bit IAR of the 7025 by a 3-bit Page Register and allows direct addressing of any store location. Further facilities provided include use of a Memory Reference Instruction set together with indirect addressing and auto-increment of indirect address. The software back-up will consist of an Assembler, load and punch routines, Editor and De-bugging programs.

Ref. Ekco Instruments Ltd.

Auxiliary Controller 7080

This will essentially find use in systems having 'read-only' memories and extends the control and processing power of the 7025 by providing five additional read/write registers:

A Register - 12-bit, incrementing, with front panel output capable of driving 'External Address' on 7025.
B Register - 8-bit, for storing sub-routine return-addresses or data bytes.
C Register - 24-bit, with front panel outputs for intrinsic OR connections to the 'Program' highway.
D Register - 24-bit, typically used as second data buffer for 7025.
E Register - 16-bit, incrementing, used as counter for program control or as additional register to B.

Ref. Ekco Instruments Ltd.

SERIAL INPUT MODULES (SCALERS)

Quad 100MHz Scaler Model 84

This unit is a 4-channel high-speed CAMAC-compatible 24-bit scaler. It features a discriminator front end to provide reliable counting independent of input waveshape. Inputs are fully protected against transients, and will count pulses as narrow as 3 ns, at rates in excess of 100 MHz (125 MHz typical). Buffered open-collector carry or overflow outputs are provided which may be wired to patch pins if desired. Data is read out on the CAMAC Dataway upon receipt of appropriate command. All functions are fully decoded, to provide unique responses to commands, and all Dataway inputs and outputs conform to CAMAC (EUR 4100 e) specifications. Scaler input-gating is controlled by the Dataway Inhibit or a front panel high-speed inhibit input. Under no circumstances will an inhibit gate signal cause the scalers to count. A front-panel light is provided to indicate when the module is addressed (N) and a light is provided to indicate when the scaler gate is open. In addition, the Model 84 is capable of performing a number of other functions, by simple modification at the factory or by the user. The unit may be used as a 4-channel time-interval meter by simply moving a jumper, which will allow the unit to count the inhibit signal. By applying the signal to be timed to one of the channel inputs and injecting the clock into the inhibit input, the unit will now count the clock as long as the input signal is low. A clock as high as 100 M Hz may be used providing a resolution of 10 ns. Overflow flip-flops for each channel can also be added. These allow an overflow flip-flop to be triggered at either the overflow of bit 15 or bit 23, and be read out on the Dataway on the appropriate read line (R16 or R24). These overflows may also be wired to open-collector buffers for readout on patch pins. It is felt that the versatility of this module will allow it to solve many of the timing and counting applications that now exist.

Functions used: F(0), F(9), F(25).
Single-width unit.
Availability: April 1971.

Ref. Jorway Corporation

PARALLEL INPUT MODULES

Discriminator-Coincidence Register Model 2340

This unit has been designed to combine the functions of discrimination of raw photomultiplier pulses and coincidence measurement. This unit contains 16 independent tunnel-diode variable-threshold discriminators with a minimum threshold of −60 mV and typically less than 800 ps slewing characteristics. Each discriminator delivers a narrow standardised timing pulse which is used to indicate coincidences with the common external gate. The 16 channels of latched coincidence data then appear on the CAMAC Dataway.

Functions used: F0, 2, 9, 25 (F2, 9 may generate Q by jumper option).

Double-width unit.
Availability: May 1971.

Ref. Lecroy Research Systems Corporation

MANUAL INPUT MODULES

Parameter A. 022 and Word Generator 9020

These two modules provide a convenient means of reading numbers set up manually into a system program so that parameters which require frequent modification can be easily changed. The Parameter Unit (Fig. 1) provides four 4-decade decimal switches which may be used for example in a multichannel analyser system to set-up channel markers and count limits. The Word Generator (Fig. 2) provides 24 binary switches.

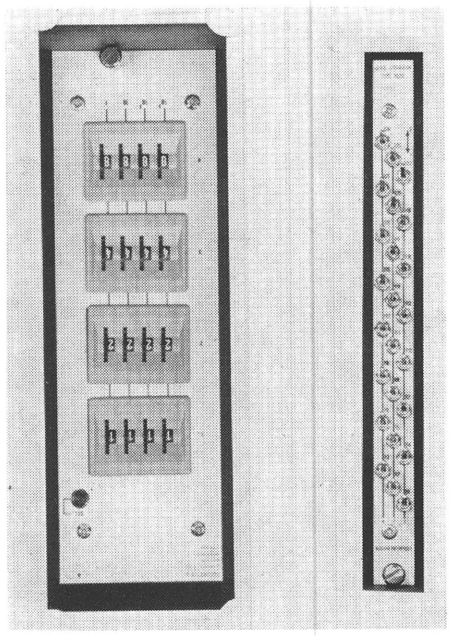


Fig. 1 Parameter A.022

Fig. 2 Word Generator 9020

Ref. Nuclear Enterprises Ltd.

PARALLEL OUTPUT MODULES

12-Bit Output Register Model 41

This unit provides up to 12 bits of information to be extracted from the Dataway and presented to the system as fast NIM signals or power drivers. A versatile system of updating the storage registers is offered. The data from the write lines can be strobed into storage with F(16) providing dc output levels. Pulse outputs are obtained using F(17). The register is overwritten at S1 and reset at S2. Both F(16) and F(17) will generate a strobe output signal to indicate that the register has been updated. In addition to these controls the register may also be selectively set or reset. For this the write lines are used to enable the function to be performed. Function F (20) will set to '1' any bit whose write input is a logic '1'. Function F (22) will reset to '0' any bit whose write input is a logic '1'. There is an 'N' light to indicate when the module is addressed.

Functions used: F (16), F (17), F (20), F (22) (all fully decoded).
Single-width unit.
Availability: June 1971.

Ref. Jorway Corporation

Dual 24-Bit Output Register Model 40

This unit provides up to 48 bits of information to be extracted from the Dataway for external use by the system. The data is stored in two 24-bit registers. Data can be written into the registers with F (16) and will then provide dc outputs. Pulsed data outputs can be achieved by use of write command F (17). Data will be clocked into the register at S1 and the register will be reset at S2. Data outputs are capable of sinking 50 mA. A strobe output pulse for each channel is provided to indicate when its register has been updated. An 'N' light is provided to indicate when the module is addressed.

Functions used: F(16), F(17) (all fully decoded).
Single-width unit.
Availability: June 1971.

Ref. Jorway Corporation

DISPLAY MODULES

Visual Readout Unit Model 72A

This unit scans from 1 to 7 crates and presents the data from up to 64 channels visually on a TV monitor. In a single crate system the unit performs as a crate controller. In a multicrate system the unit becomes a branch driver and utilizes the standard highway and Type A crate controllers for access to the crates. A single switch changes the operation of the 72A from Crate Controller to Branch Driver. Two modes of operation are available, a display mode and a fast-read mode. In the display mode, the scanner starts at a preselected module and scans a preselected number of channels from 1 to a maximum of 64. It looks for data channels by monitoring the Q response. When a data channel is addressed the data is clocked into a parallel memory. It is then converted to decimal along with the address information. This decimal data is then serially clocked into another memory. The raster controls take the data from this memory for presentation on the TV monitor. The use of this memory allows the CAMAC system to operate completely independent of the readout. The memory can also be interrogated by other interfaces, again allowing the system to operate during the long periods required for hard copy readout. In the fast-read mode, the scanner starts at the first module in crate 1 and proceeds to interrogate all channels for data. Missing modules or crates are automatically skipped. When a data channel is addressed the data is clocked into parallel storage as before. However, no decimal conversion is performed. This binary parallel data is presented to a rear connector along with a data ready signal. If the device using this data sends back a busy signal the data will be held. If no busy signal is received the scanner will go to the next data channel. The clock rate is approximately 100kHz. In addition to this, direct manual and electrical access to the dataway is provided for C·S2, Z·S2 and I. An automatic test mode is also provided that, on command, will generate 1 111 111 cycles, the S2 pulse of each cycle being counted. This allows a complete check of both the scalers, converter and scanner.

Availability: June 1971.

Ref. Jorway Corporation

Storage Oscilloscope Mode Generator

The 7011 Display Driver may now be extended to drive the Tektronics Storage Oscilloscopes 611 and 601 by means of the 9028 Storage Oscilloscope Mode Generator. These modules allow selection of the Hold View, Non Store and Write Through modes of the oscilloscope and initiate Erase. The Erase signal from the oscilloscope can be detected on the response line by F (27).

Ref. Nuclear Enterprises Ltd.

PERIPHERAL INPUT/OUTPUTMODULES

CAMAC Communications Controller Interface Model MC 4036

This unit provides the necessary interface conditions between CAMAC and a Micro-Consultants' Communications Multiplexer (Model COM-MVL) for 16 Teletypes, VDTs or Modems.

Single-width unit.
Availability: August 1971.

Ref. Micro Consultants Ltd.

CAMAC VID-MOS Interface Model MC 4037

This unit interfaces CAMAC to Micro-Consultants' MOS Memory (MOS-16), which has 1024 words of 16-bit, and the 4MHz ADC-STORE-DAC (VID-MOS).

This latter unit includes a 4MHz 10-bit ADC with integral sample-hold, a MOS store of 1024 word 16-bit capacity and a 10-bit DAC. During a WRITE operation, data is entered at one end of the store and shifted one position at each clock pulse. When the data emerges from the far end it may be recirculated or alternatively passed to the CAMAC interface unit. The CAMAC control provides the choice of two clock speeds so that data acquired at high speed may subsequently be replayed at a lower speed. A DAC allows the data to be reconstituted into an analogue signal.

Single-width unit.
Availability: August 1971.

Ref. Micro Consultants Ltd.

CAMAC MOD 15 Interface Model MC 4038

This unit provides an interface to CAMAC for Micro-Consultants' Video ADC (Model 802 RAD), a Programmed ADC and Scanner (Model SCAN), and a Multiplexed ADC (Modular 15). These ADCs have 8-bit (66 ns), 16-bit and 8 to 15-bit capability respectively.

Modular-15 can provide 256 channels at 5kHZ rate. The input sensitivity for each channel may be set from ±10mV to ±100V full-scale and input signals are amplified, filtered and parallel-sampled before conversion.

Single-width unit.
Availability: August 1971.

Ref. Micro Consultants Ltd.

CODE CONVERTERS

Binary to BCD Converter 7068 & Digital Display 0705

Binary numbers of up to 24 bits may be taken from the dataway and counted to binary-coded-decimal by the 7068 which has a conversion time of 12μs. The output is available on the front panel sockets, and can be displayed as 8-digit decimal numbers on the 0705 Decimal Display, and may also be read back onto the dataway.

The Crate, Station and Sub-address may also be displayed on the 0705 and front panel switches allow these parameters to be selected by the user and coupled into the dataway by an input gate unit, such as the 7060.

Ref. Nuclear Enterprises Ltd.

ANALOGUE-TO-DIGITAL CONVERTERS (ADC,DVM)

12-Bit Analogue-to-Digital Converter Model 30

This is a high performance 12-bit analogue-to-digital converter. It features 100MΩ input impedance, 20μs conversion speed, and high accuracy. There is provision for 3 input voltage ranges that can be internally selected. An output buffer storage is provided which simplifies system operation. Conversion may be initiated either externally or by a dataway command. A status signal is provided to indicate when a conversion is taking place. Normally, at the end of a conversion the digital information is transferred to a buffer storage register for readout. Logic is provided, however, to inhibit updating of the storage during a read operation. In this case, the storage will not be updated until after the readout is complete. The status signal will also be extended until the data for that conversion is in storage. Whenever new data is strobed into the registers a LAM flip-flop is triggered to indicate this to the dataway controller. The LAM flip-flop will be reset during a read operation at S2. An 'N' light is provided to indicate when the module is addressed.

Functions used: F (0), F (8), F (10), F (24), F (28) (fully decoded).
Double-width unit.
Availability: June 1971.

Ref. Jorway Corporation

Multi-Mode Linear ADC Model 2243

This unit is an extremely flexible device, capable of measuring either the area or the peak of pulses of either polarity to 8-bit (plus overflow) accuracy. The linearity actually extends beyond 8-bits well into the 9th overflow bit. The built-in linear gate of the ADC permits pulse integration for durations as small as 3ns. For pulses of rise-time in excess of 50ns, the 'peak' mode may be used. Full-scale input is ±7.5 V.ns (e.g. ±1 V during 7.5 ns) in the 'Area' mode and ±1V in the 'Peak' mode.

Functions used: F0, 2, 9, 25 (F2, 9 may generate Q by jumper option).
Single-width unit.
Availability: April 1971.

Ref. Lecroy Research Systems Corporation

DIGITAL-TO-ANALOGUE CONVERTERS (DAC)

12-Bit Digital-to-Analogue Converter Model 31

This is a high precision 12-bit digital-to-analogue converter. It features high accuracy, internally selectable output ranges and a 5μs conversion speed. Data to be converted is stored in a buffer register for conversion. An output signal is provided to indicate when the storage register has been updated and a new conversion is taking place. An 'N' light is provided to indicate when the module is addressed.

Functions used: F (16) (fully decoded).
Single-width unit.
Availability: June 1971.

Ref. Jorway Corporation

TIME-TO-DIGITAL CONVERTERS

Quad 9-bit Time-to-Digital Converter Model 2226A

This unit is a 9-bit version of Model 2226 TDC. The 2226A responds to one NIM-level start pulse and four individual stop pulses, digitizing the four time differences to 9-bit (plus overflow) accuracy. On the standard unit, the switch-selectable full-scales of the device are 102ns and 510ns, giving calibrated measurements of 200ps/bit and 1ns/bit. Full scales up to 10μs may be obtained by special request.

Functions used: F0, 2, 9, 25 (F2, 9 may generate Q by jumper option).
Single-width unit.
Availability: June 1971.

Ref. Lecroy Research Systems Corporation

CRATES – WITH DATAWAY, NO POWER

CAMAC Crate

Mechanical problems with CAMAC equipment are avoided by the application of high precision manufacturing processes with the help of special tools and a construction well related to the allowed tolerances. As a result, available units are really interchangeable.

Within the crate, the equidistant holes for positioning of Dataway connectors and plastic guide rails are punched during one working process to give improved accuracy of alignment. To improve the mechanical stability of the crate frame, profiled side-sheets are applied.

Ref. Hans Knürr K.G.

CAMAC Crate Model UNICRATE

The UNICRATE conforms to the CAMAC specifications. Available in 5U plain or ventilated 6U, the normal depth of 380mm may be increased up to 525mm maximum. The one piece connector rail permits separate assembly and processing of connectors with guaranteed re-alignment. The intermediate tie struts prevent displacement of connectors under insertion load. Full station identification is provided at front and rear. CAMAC crates allow the insertion of AEC/NIM modules providing the recommended adaptor is fitted.

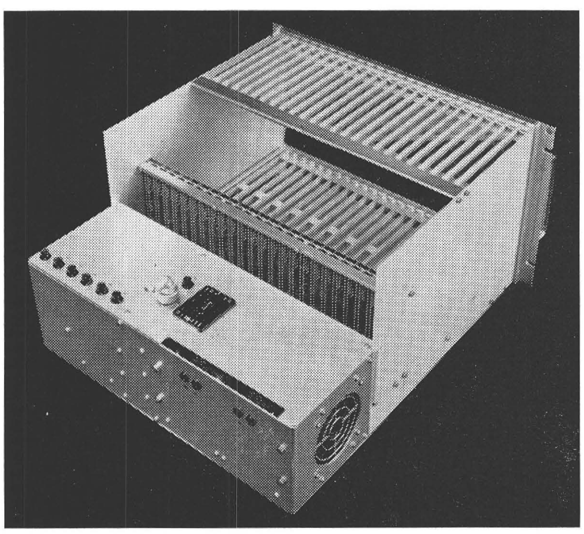
All connectors complying to CAMAC specification fit the connector rail as does the 'Motherboard' system. Safety stops are available to prevent incorrect insertion of module.

Ref. Willsher & Quick Ltd.

CRATES – WITH DATAWAY AND POWER

Power Unit 9022 & Powered Crate 9023

The Power Unit 9022 supplies the mandatory CAMAC voltage lines and fits onto the back of a 7005 Crate. The current ratings of the various lines are +6 V 15 A, −6 V 3 A, ±24 V 2 A, +200 V 50mA. A 117V supply is also provided. The Powered Crate 9023 consists of this power unit assembled onto the Crate.



Power Unit 9022 and Powered Crate 9023

Ref. Nuclear Enterprises Ltd.

Powered CAMAC Crate Model CPU/8

This crate has been designed to meet the requirements of all users of CAMAC equipment. The power supply in particular is extremely flexible, facilitating the easier distribution of the power available.

The crate used is the well-established Imhof unit which is noted for its high degree of mechanical tolerance. The Dataway is the multi-layer printed-circuit board type which has been approved and individually tested by AERE, Harwell, UK.

The power supply provides ±6V and ±24V to the crate. A total of 25A is available for the 6V lines and can be drawn from either line, the same applies with the 6A available for the 24V lines. All these voltages are stabilised and have electronic re-entrant overcurrent protection. In addition to these, there is also 200 V 50 mA unstabilised dc available for driving neon indicators.

All the outputs are metered for current and voltage and there are also test points available on the front panel. Indications are also given that the lines are functioning normally or that the cooling has failed. An output facility is available to feed power to auxiliary crates for which no power is available.

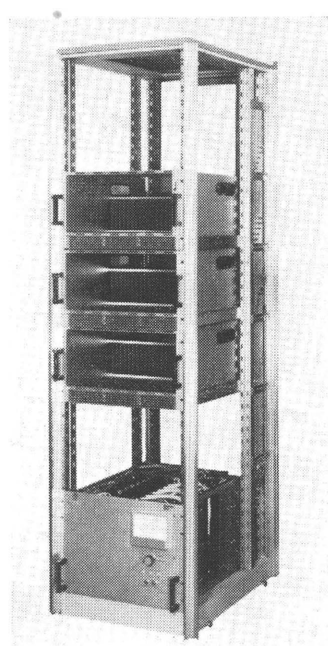
The crate is blown by means of two fans drawing air from the slot on the front panel, thus enabling appreciably more than the 200W recommended power to be taken by the cards in the crate.

Ref. Grenson Electronics Ltd.

POWER SUPPLIES AND SUPPLY CONTROLS

Rack Power Supply with High Current Rating (2 kW)

This power supply arrangement is designed for large experiments in physics that use CAMAC and which demand both a reserve of power and great flexibility in the value and polarity of distributed



Rack BC 42 with ALB/10 and 3 crates CM 5125-63 D/ALB supplies. The arrangement can be supplied complete with a rack (which permits the easy use of crates equipped with post-regulator modules) of height 42 U and depth 700 mm.

The supply comprises a pre-regulator (Model ALB 10) in an 8 U crate, to be mounted at the bottom of a rack (pre-wired model BC 42), and post-regulator units (Models BPR) which can be plugged into the back of a CAMAC crate (Model CM 5125 63 D/ALB).

This arrangement permits one or two racks, each containing 5 CAMAC crates, to be powered from a single pre-regulated ALB 10. The maximum power available is 2 kW. Furthermore, the modularity of the BPR units allows one to have the appropriate supplies without having to pay for unwanted regulated supplies.

Provisional Technical Specifications:

Pre-regulator ALB 10

Line Voltage: 220 – 380 V, 50 Hz, 3-phase.

Outputs:	+ve or −ve	6 V	125 A
	−ve or +ve	6 V	25 A
		±12 V	10 A
		+24 V	15 A
		−24 V	25 A
		+200 V	0.5 A
		117 V (ac)	2.5 A

A monitor controls the output supplies.

BPR Post-regulator Units

These can be put in parallel and according to their positioning the voltage will be positive or negative.

BPR 625	6 V	25 A
BPR 605	6 V	5 A
BPR 610	6 V	10 A
BPR 122	12 V	2 A
BPR 125	12 V	5 A
BPR 243	24 V	3 A
BPR 245	24 V	5 A

Outputs: within ±2 % for 12 V and 24 V
within +5 to −15 % for 6 V

Regulation: $\pm 10^{-3}$ (for 100 % change in output and supply)

Regulation as function of supply: $\pm 5 \times 10^{-4}$

Temperature coefficient: $2 \times 10^{-4}/°C$.

Stability as function of time:

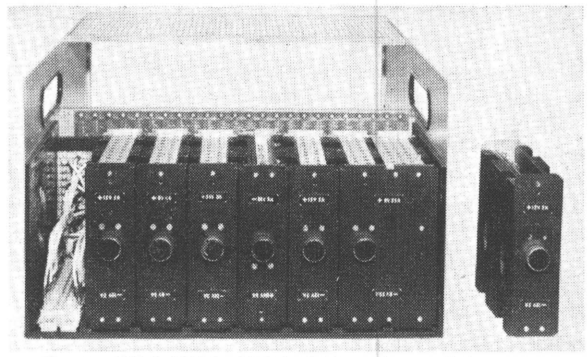
$$\left.\begin{array}{r}\text{8 hours}\\ \text{24 hours}\\ \text{6 months}\end{array}\right\} \frac{\Delta u}{u} \leqslant \pm \left\{\begin{array}{l}5 \times 10^{-4}\\ 3 \times 10^{-3}\\ 5 \times 10^{-3}\end{array}\right.$$

Ripple: ⩽ 5mV for 12 V and 24 V
⩽ 10mV for 6 V

Temperature range: 0 to + 55°C

Dynamic impedance: Up to 100 kHz ⩽ 0.3Ω

Each BPR unit has individual current limitation protection. BPR 6V units are equipped with thyristor over-voltage protection and this may be extended to the 12 V and 24 V units.



Crate CM 5125 63D/ALB with modules BPR

Ref. Saphymo Srat

MODULE PARTS

CAMAC Modules and Printed-circuit Cards

A comprehensive range of modules is available to meet CAMAC requirements. All are complete with captive, self-jacking, screw fixings in M4 or 632 UNC thread form. Back plates are available to suit. A detail drilling, piercing and engraving service is also offered. All modules are sold fully assembled and printed circuit cards may be fitted without dismantling the module. Hinge down facility provides for inter-card service access.

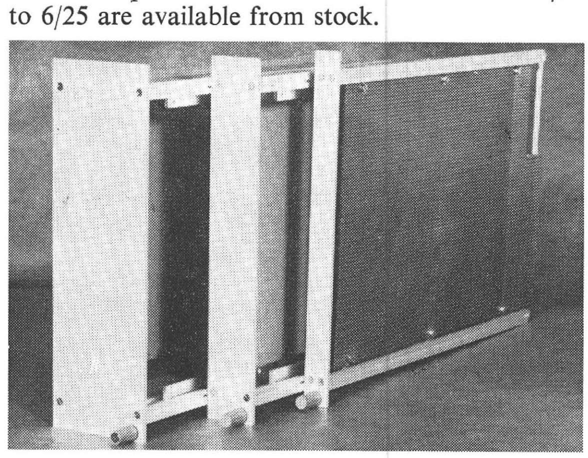
Extender modules for external assembly and test work are also available. Black anodized, screw fixed, side screens can be fitted to all modules.

Ref. Willsher & Quick Ltd.

CAMAC Modules

Mechanical problems with CAMAC equipment are avoided by the application of high precision manufacturing processes with the help of special tools and a construction well related to the allowed tolerances. As a result, available units are really interchangeable.

Within modules, the printed-circuit boards are fixed all along their length to an aluminium profile by screws; this assures evenness of the boards. The same construction principles, but different profiles, are applied for single-width (1/25) and double-width (2/25) modules to allow sufficient ventilation. The high mechanical stability of the modules avoids damaging their printed-circuit boards over long time periods. Modules with widths of 3/25 up to 25/25 are manufactured by the use of the single-width unit profiles. Modules with a width from 1/25 to 6/25 are available from stock.



Ref. Hans Knürr K.G.

General-purpose IC Patchboard Model GSPK CAMAC 164

The printed-circuit board CAMAC 164 has been developed, in conjunction with Daresbury Nuclear Physics Laboratory, so that the user can produce one-off circuits of high complexity with integrated circuits (ic's) using the minimum of wiring. The board will accommodate one wire-wrap pin for every connection from the ic and provision is made for the power supply stabilization circuit. Power rails are connected to the sets of holes for mounting the dual-in-line ic's. Input to the circuit is via an 86-way, double-sided, 0.1 inch pitch connector. All 86 plug fingers are terminated in a pad for wire-wrap or soldered connections. Two sets of 53 pads are provided for additional in/out connections.

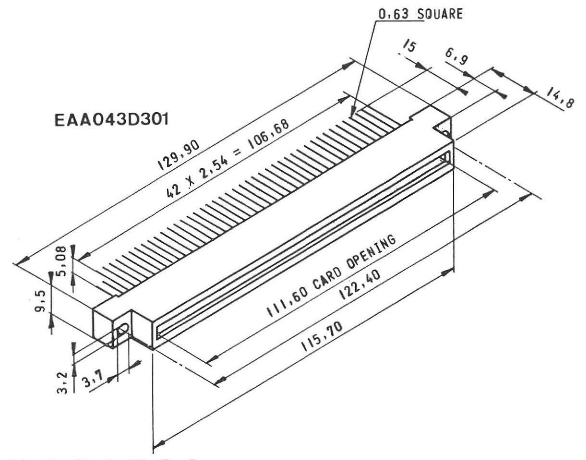
Dimensions:	11.2 × 7.25 inches.
Material:	1/16th inch, double-sided fibre glass to G.10 specification.
Finish:	Bright tin electroplated. Plated-through holes. Connections hard-gold plated.
Facilities:	Accommodates 33 × 16/14 lead plus 5 × 24 lead dual-in-line ic's.
Input/Output:	Gold-plated fingers, 86-way, double-sided, 0.1 inch pitch, and 53 × 2 rows of wiring pads.

Ref. GSPK Electronics Ltd.

DATAWAY COMPONENTS

Miniwrap Dataway Connector Type EAA 043 D 301

This connector developed by SABCA conforms to the French norm CCTU 08-13, Type HE 901. Bent beryllium-copper contacts are profiled in a way which assures maximum contact surface. The contacts are nickel-gold protected. The connector bodies are moulded by the application of short glass fibre filled diallyl phthalate. The nominal voltage between contact is 200 V rms (50 Hz) and the current rating is 3A per contact.



Ref. S.A.B.C.A.

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).*

ESONE AND CAMAC NEWS

CAMAC PAPERS AT 1971 NUCLEAR SCIENCE SYMPOSIUM NOV 3-5, 1971, SAN FRANCISCO, CALIFORNIA

CAMAC in Real-Time Computer Systems—I. N. Hooton, A. E. R. E., Harwell, England

CAMAC Microprogrammed I/O Processor—J. A. Buchanan, Rice University.

ALGEN—A Microprogrammable CAMAC Branch Driver Controller—A. E. Oakes, Lawrence Berkeley Laboratory

Versatile PDP-11 CAMAC Crate Controller for Nuclear Data Acquisition and Processing—H. Halling, K. Zwoll and K. D. Müller, Zentrallabor für Elektronik, Julich, Germany

Unified Data Acquisition and Analysis under JANUS Operating System—R. Au, Michigan State University

A Proportional Chamber System for the SLAC 20 GeV Spectrometer—E. Bloom, R. Cottrell, G. Johnson, C. Prescott, R. Siemann and S. Stein, Stanford Linear Accelerator Center.

Some Software Implications of CAMAC Instrumentation—A. Lewis, A. E. R. E., Harwell, England

Yale-NAL CAMAC System—S. Dhawan, Yale University

CAMAC Discriminator—Gated Latch with Digital Multiplicity Design Logic—B. Bertolucci and D. Horelick, Stanford Linear Accelerator Center.

CAMAC PRODUCT GUIDE

This guide consists of a list of CAMAC equipment which is believed to be offered for sale by manufactures in Europe and the U.S.A. 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 17th July, 1971.

The number of items of commercially available CAMAC equipment is increasing rapidly, the current list containing some 40% more entries than in Issue 1 of the Bulletin. It is therefore not possible to guarantee the completeness or accuracy of this list, although 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 specification 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 list contained in Issue No. 1. For example, the width of the units is now given (1, 2, etc, for CAMAC format; NA for other formats; and O if not known). The date on which units became, or will become, available is also included.

In addition, a reference is given, in the column 'NPR', to the issue number of the Bulletin in which the listed item was described under the New Product Section. As before the list includes the name of the company concerned and is followed by a list of full names and addresses of all the companies. In some cases, the manufacturer's designation of the unit is followed by explanatory comment in brackets.

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/0 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.

Most CAMAC units in this list have generalised front-panel connections, with signal standards and connectors following the CAMAC recommendations. Some other units, including computer interfaces, are fully compatible with the CAMAC crate and Dataway but have specialised external connections for use with particular items or classes of equipment. In this list some units with specialised non-CAMAC front-panel connections are marked thus*, and units with specialised interconnections to controllers are marked thus §; new entries are marked 'N'; and changed entries 'C',

CLASSIFICATION GROUPS

INDEX OF PRODUCTS

	DESIGNATION + SHORT DATA	TYPE NO.	MANUFACTURER	WIDTH	DELIV.	NPR
BRANCH HIGHWAY RELATED SYSTEM UNITS (Computer Couplers, Crate, Controllers, Terminations)						
	Interface for HP 2114B/2115B/2116B	2200 SER	Borer	NA		
N	PDP-11 CAMAC Controller (Sequential read and write, 24 Graded-L interrupts directly).	CA 11-A	DEC	NA	05/71	(2)
	PDP-15 CAMAC Interface (18/24bit Formats, Progr, Control + Block Transfer modes).	CA 15 A	DEC	NA	05/71	(1)
N	PDP-9 CAMAC Interface (somewhat modified CA 15 A)	CA 15 A/PDP-9	DEC	NA	07/71	
N	PDP-11 Branch Driver	BD-011	EG-G	NA	/71	
N	PDP-11 Interface System	SI-11	GEC-Elliott	NA		
N	Executive Controller (Part of SI-11)	MX-CTR-1	GEC-Elliott	2		
N	Branch Coupler(Part of SI-11)	BR-CPR-1	GEC-Elliott	2		
N	*Programmed Transfer Interface (Part of SI-11)	PTI-11	GEC-Elliott	1		
N	Termination Module (Part of SI-11)	TRM-11	GEC-Elliott	1		
N	*Interrupt Vector Generator (Part of SI-11)	IVG-11	GEC-Elliott	1		
N	*Data Break Interface (Part of SI-11)	DMA-11	GEC-Elliott	1		
	Branch Crate Controller Type A (EUR 4600 compatible)	70	Jorway	2	01/71	
N	Display/Crate-Ctrl + Branch Driver (Control unit for 72A system)	72A	Jorway	3	07/71	
	PDP 11-Branch Driver		SEN	2	06/71	
	Crate Controller (ESONE Type A Conforms to EUR 4600)	1501	Borer	2	01/71	
	Crate Controller (ESONE'A')	CC 2404	GEC-Elliott	2	01/71	
N	Crate Controller Type A (following CAMAC Spec. EUR 4600e)	C 106	RDT	2	06/71	
	Crate Controller (according to EUR 4600 Specification)	JCRC50	SAIP-CRC	2	02/71	(1)
	'A' Crate Controller	ACC 2034	SEN	2	06/71	
N	CAMAC Crate Controller	CC 100	EG + G	2	05/71	
	Crate Controller	CC 2402	GEC-Elliott	2	01/71	
	Crate Controller (A)	C72451-A1446-B1	Siemens	2	10/70	(1)
	Termination Unit	1591	Borer	2		
N	Branch Highway Terminator	TC024	EG+G	2	/71	
	Branch Termination Unit	BT 6601	GEC-Elliott	2	01/71	
	Branch Termination	50	Jorway	2	01/71	
N	Crate Controller Bus Terminator		SEN	NA		
DATAWAY RELATED SYSTEM UNITS (Computer Couplers, Controllers)						
	*Auxiliary Controller PDP-8	7049-1	EKCO Instruments Nucl. Enterprises	3		
	*Dataway Controller PDP-8	7048-2	EKCO Instruments Nucl. Enterprises	2	/70	

	DESIGNATION + SHORT DATA	TYPE NO.	MANUFACTURER	WIDTH	DELIV.	NPR
	*Crate Controller for PDP-8 (Interfaces up to 7 crates with 4 device addresses)	FHC 8001 A	Frieseke	2	10/70	
	Crate Ctr for Nova Computer	CC 2023A/B	SEN	2	/70	
	*Dataway Controller DDP-516	7022-1	EKCO Instruments Nucl. Enterprises	4	/70	
N	Computer Interface		Interdata	0	07/71	

OTHER SYSTEM UNITS

	DESIGNATION + SHORT DATA	TYPE NO.	MANUFACTURER	WIDTH	DELIV.	NPR
	§Plugboard Store	7077-1	EKCO Instruments Nucl. Enterprises	3		
	Programmed Dataway Controller	7025-2	EKCO Instruments Nucl. Enterprises	2	/70	
	§Wired Store	7044-1	EKCO Instruments Nucl. Enterprises	1	/70	
	Plugboard Store	0361-2	EKCO Instruments Nucl. Enterprises	NA	/70	
	Program Control Unit	0362-2	EKCO Instruments Nucl. Enterprises	NA	/70	
	*Start-Stop-Unit (100Hz clock, Manual and Dataway Control)	FHC 1304	Frieseke	1	01/71	(1)
	Readout Control Unit	2152	LRS-LeCroy	3	01/71	
N	General Interface	2770	LRS-LeCroy	NA		
N	LAM Grader (CERN SPC 064)	C 107	RDT	1	06/71	
	Start-Stop Module (for chronometry set)	JAM 10	SAIP-CRC	1	01/71	
	Four-fold Busy-Done (Start signal initiated by command, device returns LAM)	4BD 2021	SEN	1	02/71	
N	Overflow-Inhibit-Driver	C72451-A1454-A1	Siemens	0	01/71	
	Overflow-Driver	C72451-A1452-A1	Siemens	0	10/70	
N	Store	N600	Texas Instruments	0	07/71	
	Auxiliary Controller	7047-1	EKCO Instruments Nucl. Enterprises	1	/70	
	§Command Generator	7062-1	EKCO Instruments Nucl. Enterprises	2		
	§Local Intercrate Interface	7033-1	EKCO Instruments Nucl. Enterprises	2	/70	
	§Local Slave Dataway Controller	7034-1	EKCO Instruments Nucl. Enterprises	2	/70	
	§Remote Intercrate Interface	7035-1	EKCO Instruments Nucl. Enterprises	2	/70	
	§Remote Sub-master Dataway Controller	7036-1	EKCO Instruments Nucl. Enterprises	2	/70	
	§Sequential Command Generator	7037-1	EKCO Instruments Nucl. Enterprises	2	/70	
	§Store Interface (for 4k × 8 bit core store, used with 7025)	7067-1	EKCO Instruments Nucl. Enterprises	0	/71	(2)
	§Auxiliary Controller (for 7025)	7080-1	EKCO Instruments Nucl. Enterprises	0	/71	(2)

MANUAL CONTROLLERS AND TEST EQUIPMENT

	DESIGNATION + SHORT DATA	TYPE NO.	MANUFACTURER	WIDTH	DELIV.	NPR
	Manual Dataway Controller	7024-1	EKCO Instruments Nucl. Enterprises	8	/70	
N	Manual Dataway Controller	C 108	RDT	8	06/71	

	DESIGNATION + SHORT DATA	TYPE NO.	MANUFACTURER	WIDTH	DELIV.	NPR
	Manual Crate Controller	JCMC 10	SAIP-CRC	8	06/71	
	Manual Branch Control Set (incl. one Manual Branch Controller Type TCMB)	CCMB 10	SAIP-CRC	0	09/71	(1)
N	CAMAC Dataway Display (Dataway signal pattern stored and displayed, 2 test modes)	1801	Borer	1		
N	Test Module (Hardware and software test unit for BD-011)	TM 024	EG-G	2	/71	
	Dynamic Test Controller	TC 2402	GEC-Elliott	4	01/71	
	Branch Test Controller	BC 2402	GEC-Elliott	0	01/71	
	Dataway Test Module	DTM	GEC-Elliott	2	01/71	
SERIAL INPUT MODULES (Scalers)						
	Counting Register	7070-1	EKCO Instruments Nucl. Enterprises	1	/70	
	Quad Counting Register	706-2	EKCO Instruments	1		
	Fast 24 bit Scaler (20MHz with fast NIM, or 10MHz with TTL input)	JEB 10	SAIP-CRC	1	01/71	
	Special 24 bit Scaler (25MHz)	JEB 15	SAIP-CRC	1	10/70	
C	25MHz-Zahler (24 bit scaler)	C72451-A1330-A1	Siemens	1	10/70	
	Dual Counting Register (2×12-bit)	701-1	EKCO Instruments	1		
C	Counter 250MHz	C72451-A1448-A1	Siemens	0	10/70	
	Miniscaler (2×16 bit, 30MHz)	1002	Borer	1	11/69	
	Dual Counting Register	702-1	EKCO Instruments	1		
	Miniscaler (2×16 bit, 30MHz)	002	Nucl. Enterprises	1	/71	
N	Miniscaler (30MHz 2×16 bits) CERN 002	C 104	RDT	1	06/71	
	Dual 150MHz 16 bit Scaler (one 50 ohms, one untermin. NIM input/scaler)	2S 2024/16	SEN	1	/70	
	Dual 150MHz 24 bit Scaler (one 50 ohms, one untermin. NIM input/scaler)	2S 2024/24	SEN	1	/70	
	Microscaler (4×16 bit, 25MHz)	1003	Borer	1	05/69	
N	Quad 50MHz Scaler (50MHz, 16 bit, NIM signals)	S 416	EG+G	1	/71	
	Quad Counting register	709-2	EKCO Instruments	1		
	M/S Readout Serial Register	SR 1604	GEC-Elliott	1	01/71	
	Serial Register	SR 1605	GEC-Elliott	1	01/71	
	Quad 40MHz Scaler	SR 1606	GEC-Elliott	1	01/71	
	Dual 100MHz Scaler (2×24 bin. bits or 2×6 BCD digits, discr. level −0,5V)	80A	Jorway	1	10/70	
	Microscaler (4×16 bit, 25 MHz, optimized input, 3ns, gives typ, 75MHz counting)	003-4	Nucl. Enterprises	1	/71	
N	Quad Scaler	9015	Nucl. Enterprises	0	/71	
N	Microscaler 25MHz (4×16 bits, CERN 003)	C 102	RDT	1	06/71	
	Fast 4×16 bit Scaler (25MHz with TTL or fast NIM input)	JEB 20	SAIP-CRC	1	01/71	
	Four-fold 16 bit Scaler CERN Specs 003 (50MHz, also 2×32bit, NIM inputs and gate)	4 S 2003/50	SEN	1	/69	

	DESIGNATION + SHORT DATA	TYPE NO.	MANUFACTURER	WIDTH	DELIV.	NPR
	Four-fold 16 bit Scaler (40MHz typ, each scaler has A 50 ohms, B untermin. NIM input)	4 S 2004	SEN	1	/70	
N	Quad 150 MHz Scaler (125 to 150MHz continuous oper, 24 bits, NIM signals)	S 424	EG+G	1	/71	
N	Serial Register	SR 1608	GEC-Elliott	1		
	Quad 100MHz Scaler (4×24 bit, discr. level −0,5 V, also time-interval operation)	84	Jorway	1	03/71	
C	Quad 125MHz 24-bit Scaler	2550 B	LRS-LeCroy	1	08/70	
	CAMAC 100MHz Quad Scaler (4×16 bit, switchable to 2×32, 50 ohms in, inhibit, ovf-LAM)	263	Nucl. Measurement	1	01/70	
	Four-fold 16 bit Scaler 100MHz	4 S 2003/100	SEN	1	/70	
	Dual Counting Register (BCD)	7040-1	EKCO Instruments Nucl. Enterprises	1	/70	
	Dual Counting Register	700-1	EKCO Instruments	1		
	BCD Scaler	9021	Nucl. Enterprises	0	/71	
	Quad Counting Register	707-2	EKCO Instruments	1		
	Quad Counting Register	708-2	EKCO Instruments	1		
N	Octal 50MHz Scaler (12 bit octal, 40MHz, each sc. outputs inhibit, NIM signals)	S 812	EG+G	1	/71	
	Bidirectional Counting Register	7071-1	EKCO Instruments Nucl. Enterprises	0	/71	
	Dual Coordinate Recorder	XYRCDR/042	SAIP-CRC	1	10/70	

PRESET COUNTING MODULES (Scalers, Timers)

	Preset Scaler (30MHz, 24 bit)	1001	Borer	1	/70	(1)
	Preset Scaler (1×24 bit, 30MHz)	FHC 1201A	Frieseke			
	Preset Counting Register (24 bit)	703-1	EKCO Instruments	1	/70	
	Preset Counting Register (16 bit)	7039-1	EKCO Instruments Nucl. Enterprises	1	/70	
	Preset Counting Register (4 decades BCD)	704-1	EKCO Instruments	1	/70	
	24 bit BCD Preset Scaler /Timer	FHC 1301	Frieseke	2		
	24 bit BCD Preset Scaler/Timer	FHC 1302	Frieseke	1		
	6 decade BCD Preset Scaler	JEP 20	SAIP-CRC	2	/70	
	Preset Counting Register (6 decades BCD)	705-1	EKCO Instruments	1	/70	

PARALLEL INPUT REGISTERS

	Parallel Input Register (16 bit)	MS PI 1 1230/1	AEG-Telefunken	1		(1)
	Parallel Input Register (16 bit)	MS PI 2 1230/1	AEG-Telefunken	1		(1)
	Parallel Register (16 bit, indicating)	PR 1601-1	GEC-Elliott	1	6/71	
	Parallel Register (16 bit, indicating)	PR 1603	GEC-Elliott	2	/70	
	Parallel Input Register (16 bit)	7014-1	EKCO Instruments Nucl. Enterprises	1	/70	
	Dual 16 bit Input Register	2IR 2010	SEN	1	/70	
	Parallel Register (2×16 bit, indicating)	PR 1602	GEC-Elliott	2	/70	
	Parallel Register (2×16 bit, indicating)	PR 1604	GEC-Elliott	3		
	Dual Parallel Input Register (2×24 bit)	60	Jorway	1	/70	

DESIGNATION + SHORT DATA	TYPE NO.	MANUFACTURER	WIDTH	DELIV.	NPR
Interrupt Request Register (8 bit)	7013-1	EKCO Instruments Nucl. Enterprises	1	/70	
Priority Interrupt Register (12 bit)	63	Jorway	2	/70	
Strobed Input Register NIM (12 bit)	SIR 2026	SEN	1	/70	
Pattern Unit (16 bit) (CERN 021)	16 P 2007	SEN	2	/70	
Gated Parallel Register (8 channel)	GPR 0801	GEC-Elliott	3	6/71	
Matrix Gate (8X and 8Y inputs)	MG 6401	GEC-Elliott	3	/71	
Pattern Unit (16 bit)	021	Nucl. Enterprises	2	/71	
Fast Coincidence Latch (8 channel)	64	Jorway	1	1/71	
16 Channel Disc/Coinc. Register	2340	LRS/LeCroy	2	7/71	(2)
16 Channel Coincidence Register	2341	LRS/LeCroy	2	1/71	
PARALLEL INPUT GATES (Dataway Connecting)					
Parallel Input Gate	7017-1	EKCO Instruments Nucl. Enterprises	1	/70	
Parallel Input Gate	7018-1	EKCO Instruments Nucl. Enterprises	1	/70	
NS 628 Adapter	710	EKCO Instruments	1		
Parallel Input Gate (24 bit)	7059-1	EKCO Instruments Nucl. Enterprises	1	/70	
Parallel Input Gate (22 bit)	7060-1	EKCO Instruments Nucl. Enterprises	1	/70	
Input Data Gate (negative TTL)	713	EKCO Instruments	1		
Input Data Gate (positive TTL)	714	EKCO Instruments	1		
Dual Parallel Strobed Input Gate (data input to Dataway transfer controlled)	61	Jorway	1	10/70	
Dual Parallel Input Gate (data input to Dataway without transfer control)	61-1	Jorway	1	10/70	
MANUAL INPUT MODULES					
Parameter Unit 12 bit (provides 12 bit communication, push button L-Req.)	P 205	SEN	1	/70	
Word Generator	WG 2401	GEC-Elliott	1	01/71	
Word Generator (24 bits of Binary data, switch selected)	9020	Nucl. Enterprises	1	/71	
Parameter unit (4 × 4 decade parameters)	022	Nucl. Interprises	4	/71	
N Parameter Unit A (4 BCD parameters, 16 bits)	C 105	RDT	4	06/71	
DATA STORAGE MODULES					
Transfer Register	7063-1	EKCO Instruments Nucl. Enterprises	1	/70	
Quad Register	715-2	EKCO Instruments	1		
Quad Register	716-2	EKCO Instruments	1		
Quad Register	717-2	EKCO Instruments	1		
PARALLEL OUTPUT MODULES					
12 bit Output Register (dc or pulsed outputs, updating strobe, NIM levels)	41	Jorway	1	03/71	(2)
Output Register (12 bit NIM levels or pulses out)	OR 2027	SEN	1	/70	
Parallel Output Register	7054-3	EKCO Instruments Nucl. Enterprises	1	/70	

DESIGNATION + SHORT DATA	TYPE NO.	MANUFACTURER	WIDTH	DELIV.	NPR
Dual 16 bit Output Register (TTL levels, open collector outputs)	20 R 2008	SEN	1	/70	
Parallel-Output Register (dual 24 bit, optional 4×12, open collector TTL out)	MS P01 1230/1	AEG-Telefunken	1	10/70	(1)
Dual 24 bit Output Register (DC or pulsed outputs, 50mA drivers, updating strobes)	40	Jorway	1	07/71	(2)
Switch (12 change-over relays for ext. power switching, dataway controlled)	7066-1	EKCO Instruments Nucl. Enterprises	1		
Driver	7016-1	EKCO Instruments Nucl. Enterprises	1	/70	
Dual 16-bit Output Driver	OD 1601	GEC-Elliott	0	06/71	(1)
Dual 15-bit Power Output Driver	OD 1605	GEC-Elliott	0	06/71	(1)
Driver (16 bit)	9002	Nucl. Enterprises	1	/71	
Driver (24 bit)	9013	Nucl. Enterprises	1	/71	
Driver (24 output lines controlled by internal register)	9017	Nucl. Enterprises	1	/71	(1)
Dataway Buffer (all dataway signals output to front panel)	9018	Nucl. Enterprises	1	/71	(1)

DISPLAY MODULES

DESIGNATION + SHORT DATA	TYPE NO.	MANUFACTURER	WIDTH	DELIV.	NPR
Display Driver X-Y-Z	DD 2012	SEN	1	4/71	(1)
Storage Display Driver	SDD 2015	SEN	1	4/71	(1)
Character Generator	CG 2018	SEN	1	4/41	(1)
Vector Generator	VG 2028	SEN	1	5/71	(1)
CRT Alphanumeric Display System	71	Jorway		6/71	
Display Alphanumeric Character Generator	2759	LRS/LeCroy	2	/70	
24 bit BCD display (for Scaler/Timer)	FHC 1305	Frieseke	1		(1)
6 Decade Nixie Display (for Scaler/Timer)	FHC 1306	Frieseke	2		(1)
Decimal Display	JAF 15	SAIP-CRC			
Display Driver (for CRT display)	7011-2	EKCO Instruments Nucl. Enterprises	2	/70	(1)
Visual Readout Unit	72A	Jorway	NA		(2)
N Storage Oscilloscope Mode Generator	9028	Nucl. Enterprises	0	/71	(2)

PERIPHERAL INPUT/OUTPUT MODULES

DESIGNATION + SHORT DATA	TYPE NO.	MANUFACTURER	WIDTH	DELIV.	NPR
Print Drive Unit	PDT 01	GEC-Elliott	NA	01/71	
Print Control Unit	PC 2402	GEC-Elliott	2	01/71	
Typewriter Drive Unit	TD 0801	GEC-Elliott	NA	08/71	
*Teletypewriter Driver	7043-1	EKCO Instruments Nucl. Enterprises	1	/70	
*Teletypewriter Interface	7061-1	EKCO Instruments Nucl. Enterprises	1	/70	(1)
§Input-Output Interface (Teletype-Dataway I/O Transf., 12 scaler op. on spec. bus)	FHC 1307	Frieseke	2	01/71	(1)
§Teletype Interface	2720	LRS/LeCroy	2	05/71	
§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)

	DESIGNATION + SHORT DATA	TYPE NO.	MANUFACTURER	WIDTH	DELIV.	NPR
	Tape Reader Interface Unit	TR 0801	GEC-Elliott	1	01/71	
	Peripheral Driver (TTL levels, handshake controls)	7065-1	EKCO Instruments Nucl. Enterprises	1		(1)
	Peripheral Reader (TTL levels, handshake controls)	7064-1	EKCO Instruments Nucl. Enterprises	1		(1)
	*B.S. Interface Reader	7075-1	EKCO Instruments Nucl. Enterprises	1		(1)
	*B.S. Interface Driver	7058-1	EKCO Instruments Nucl. Enterprises	1		(1)
N	Stepping Motor Drivers (used with 7045)	0707, 8, 9	EKCO Instruments Nucl. Enterprises	NA	/71	
	*2110 Reader (Adaptor for serial ADC)	7012-1	EKCO Instruments Nucl. Enterprises	1	/70	
	*Interface for Converters CA 13B, CA 25 or C 97.	JCCA 10	SAIP-CRC	2	01/71	
N	CAMAC Communications Controller Interface unit	MC 4036	Micro Consultants	1	08/71	(2)
N	CAMAC VID-MOS Interface Unit	MC 4037	Micro Consultants	1	08/71	(2)
N	CAMAC MOD 15 Interface Unit	MC 4038	Micro Consultants	1	08/71	(2)
	Delayed Pulse Generator (for stepping motors)	7045-1	EKCO Instruments Nucl. Enterprises	1	/70	
N	Output Register (16 or 24 bit TTL driver for fast-routing multiplexer system)	CM 665	J and P	1	07/71	
	*Spark Chamber Read-Out	SCRO 041	SAIP-CRC	2	10/70	
	*SCRO TML (for SCRO 041)	NP 043	SAIP-CRC	5	10/70	
	Dual Incremental Position Encoder (2 coordinates strobed by command or ext.)	2IPE 2019	SEN	1	04/71	
	Light Pen for DD2012 or CD2018	LP 2035	SEN	NA	06/71	

CODE CONVERTERS

	DESIGNATION + SHORT DATA	TYPE NO.	MANUFACTURER	WIDTH	DELIV.	NPR
	Binary to BCD Converter	7068-1	EKCO Instruments Nucl. Enterprises	1	/70	
	24-bit Bin. to BCD Converter	BCD 2401	GEC-Elliott	0	08/71	(1)
	Binary to BCD (ASC II) Converter	2253	LRS-LeCroy	2	10/70	

ANALOGUE-TO-DIGITAL CONVERTERS (ADC, DVM)

	DESIGNATION + SHORT DATA	TYPE NO.	MANUFACTURER	WIDTH	DELIV.	NPR
	Analogue to Digital Converter	7028-1	EKCO Instruments Nucl. Enterprises	1	/70	
	8-bit ADC	ADC 0801	GEC-Elliott	0	06/71	(1)
	Multi-mode Analog to Digital Converter	2243	LRS-LeCroy	1	08/70	(2)
	512 Channel ADC (range +0,1V to +2V, 10MHz clock. diff. linearity 2/100)	JCAN 31	SAIP-CRC	3	01/71	
	10-bit ADC	ADC 1001	GEC-Elliott	0	06/71	
	10 bit ADC	2245	LRS/LeCroy	1	06/71	
	Dual Digital-to-Analog Converter (10 bit conv. to max +10,2V or 5,1V bipolar)	2DAC 2011	SEN	1	04/71	
	Analog to Digital Converter	7055-1	EKCO Instruments Nucl. Enterprises	1	/70	
	12-bit ADC	ADC 1201	GEC-Elliott	0	06/71	(1)
	A/D Converter 12 bit (max 20 µs conv. time, I/P range 10V pos. or neg)	30	Jorway	2	06/71	(2)

	DESIGNATION + SHORT DATA	TYPE NO.	MANUFACTURER	WIDTH	DELIV.	NPR
	8192 Channel ADC (range +0,1V to +10V, 100MHz clock, diff. lin. 3/1000)	JCAN20C/H	SAIP-CRC	8	01/71	
N	Connector to Memory Block BM96	JCAN 201	SAIP-CRC	2	01/71	
DIGITAL-TO-ANALOGUE CONVERTERS (DAC)						
	Digital to Analogue Converter	7015-1	EKCO Instruments Nucl. Enterprises	1	/70	
	Dual 10-bit DAC	DAC 1001	GEC-Elliott	0	08/71	(1)
	D/A Converter 12 bit (conv. speed 5 µs op. ranges 2.5, 5, 10V (both polarities)	31	Jorway	1	06/71	(2)
	Dual 10 bit Digital Voltmeter (integrating type, max 0,1V pos or neg)	2DVM 2013	SEN	1	04/71	
TIME-TO-DIGITAL CONVERTERS						
	Time-to-Digital Converter	1005	Borer	1		
	M/S Readout Serial Register	SR 1604	GEC-Elliott	1	01/71	
	Quad Time-to-Digital Converter	2226A	LRS-LeCroy	1	10/70	(2)
	Quad Time Digitizer	2801	LRS/LeCroy	1	04/71	
OTHER ANALOGUE AND/OR DIGITAL MODULES						
	Hex IL2 to IL1 Converter (6 signals, 50 ohm to unterm.)	7051-1	EKCO Instruments Nucl. Enterprises	1	/70	
	Hex IL1 to IL2 Converter (6 signals, unterm. to 50 ohm)	7052-1	EKCO Instruments Nucl. Enterprises	1	/70	
	Quin L1 to IL1 Converter (5 signals, Harwell 2000 to unterm.)	7053-1	EKCO Instruments Nucl. Enterprises	1	/70	
	Fan-Out	FO 0801	GEC-Elliott	1	01/71	
	8 Channel Pulse Integrator	2227	LRS/LeCroy	1	04/71	
PULSE GENERATORS AND CLOCKS						
	Clock Pulse Generator	7019-1	EKCO Instruments Nucl. Enterprises	1	/70	
	Real Time Clock	712	EKCO Instruments	1		
	Crystal Controlled Pulse Gen.	PG 0001	GEC-Elliott	1	01/71	
	Test Pulse Generator	TPG 0202	GEC-Elliott	1	01/71	
	Time Pulse Generator	FHC 1303	Frieseke	0	01/71	(1)
	Quartz Controlled Clock (freq. range up to 1MHz, selected in decade steps)	JHO 10	SAIP-CRC	1	01/71	
	Real Time Clock (3,8 µs to 18,2 hrs range)	RTC 2014	SEN	1	04/71	
	Dual Programmed Pulse Generator (50Hz to 2kHz pulse train, length set by command)	2PPG 2016 C72454-A1450-A1	SEN Siemens	1 0	04/71 10/70	
LOGIC FUNCTION MODULES						
	Dual Gate	7020-1	EKCO Instruments Nucl. Enterprises	1	/70	
	Fan-Out	7021-1	EKCO Instruments Nucl. Enterprises	1	/70	
	Channel Selector	CS 0801	GEC-Elliott	1	01/71	
	Control Generator	CG 0301	GEC-Elliott	1	01/71	

	DESIGNATION + SHORT DATA	TYPE NO.	MANUFACTURER	WIDTH	DELIV.	NPR
DELAY AND ATTENUATOR UNITS						
	CAMAC Delay Box (1-63 ns in 1 ns steps, Dataway or manual control)	FHC 4003 B	Frieseke	1	10/70	
	Dual Attenuator	9004	Nucl. Enterprises	1	/71	
	Programmed Attenuator	JATP 10	SAIP-CRC	3	10/70	
CRATES- NO POWER, NO DATAWAY						
	Crate (empty)	MCF/5CAM/S	Imhof-Bedco	25	06/71	
	Crate (empty, with ventilation baffle, Harwell 7000-Series)	MCF/6CAM/SV	Imhof-Bedco	25	06/71	
	Crate (empty, with ventilation baffle, Harwell 7000-Series)	MCF/6CAM/SVR	Imhof-Bedco	25	06/71	
	CAMAC Crate (empty)	2,080,000,6	Knürr	25	10/70	(2)
	CAMAC System Bin		RO Associates	25	03/70	
	Chassis, Vides (Empty crates)		SAPEC S.A.	24	01/70	
N	Unpowered Crate with Dataway		Saphymo-SRAT	25		
	(360mm)	CM 5125 33D				
	(525mm)	CM 5125 53D				
	(570mm)	CM 5125 63D				
	(570mm)	CM 5125 63D/ALB				(2)
	Chassis CAMAC Normalise 5U (Empty crate)		Transrack	25	07/70	
	(360mm deep)	CM 5025 30				
	(460mm deep)	CM 5025 40				
	(525mm deep)	CM 5025 50				
	Chassis CAMAC 5U Utiles (Empty crate, with ventilation hardware)		Transrack	25	07/70	
	(360mm deep)	CM 5125 30				
	(460mm deep)	CM 5125 40				
	(525mm deep)	CM 5125 50				
	Chassis CAMAC 5U Utiles (Empty crate, with one fan)		Transrack	25	07/70	
	(360mm deep)	CM 5125 31				
	(460mm deep)	CM 5125 41				
	(525mm deep)	CM 5125 51				
	Chassis CAMAC 5U Utiles (Empty crate, with two fans)		Transrack	25	07/70	
	(360mm deep)	CM 5125 32				
	(460mm deep)	CM 5125 42				
	(525mm deep)	CM 5125 52				
	Empty Crates	UNICRATE	Willsher+Quick	24	01/70	(2)
	CAMAC Crate (Empty, incl. hardware, supply chassis and ventilation panel)	2.086.000.6	Knürr	25	10/70	
	Crate Unpowered, No Dataway	CCH	RDT	25	10/70	
N	Ventilated Crate No Power No Dataway	CCHN	RDT	25	06/70	
CRATES- WITH DATAWAY, NO POWER						
	Crate	7005-2	EKCO Instruments Nucl. Enterprises	24	/70	
	Ventilated Crate	VC 0010	GEC-Elliott	25		
	CAMAC Crate Verdrahtet (Empty crate with wired Dataway)	2.084.000.6	Knürr	25	10/70	(2)
	Unpowered Crate with Dataway and Connectors	UPC 2029	SEN	25	/70	
	Crate including Dataway, Fan, Crow-bar for Plug-in V.R.	1902	Borer	25	12/69	

	DESIGNATION + SHORT DATA	TYPE NO.	MANUFACTURER	WIDTH	DELIV.	NPR
CRATES- WITH DATAWAY AND POWER						
N	Crates with Dataway and Power	1250-0006	Duckert	25	06/71	
N	Powered Crate	MC 100	EG+G	NA	/71	
	Powered Crate (7005-2 with 9007 mounted on)	9023	Nucl. Enterprises	NA	/71	
N	Powered Crate	VC 0010/PS 0002	GEC-Elliott	25	01/71	
N	Powered Crate (+6V/25A, −6V/25A, +24V/6A, −24V/6A)	CPU/8	Grenson	24	09/71	(2)
N	Powered Crate (see P4 ALJ 12)	C4 ALJ 12 D	Saphymo-SRAT	25		(1)
N	Powered Crate (see P6 ALJ 12)	C6 ALJ 12 D	Saphymo-SRAT	25		(1)
	Powered Crate (see P7 ALJ 13)	C7 ALJ 13 D	Saphymo-SRAT	25		(1)
	Powered Crate (+6V/25A, −6V/10A, +12V/3A, −12V/3A, +24V/3A, −24V/3A, 200W)	PC 2006	SEN	25	/70	
	Crate+Power Supply		Siemens	25	/71	
POWER SUPPLIES AND SUPPLY CONTROLS						
	Power Supply	PS 0002	GEC-Elliott	NA	01/71	
N	Power Supply (Rack mounting, +6V/25A, −6V/15A, +24V/5A, −24V/5A, 200V/0,1A)	CPU/6	Grenson	NA	07/71	
N	Power Supply (Rack mounting, +6V/25A, −6V/15A, +24V/5A, −24V/5A, +12V and −12V)	CPU/7	Grenson	NA	07/71	
N	Power Supply Flexible (Modular system with plug-in types CF§/§, see below)	CPU/1	Grenson	NA	07/71	
N	CAMAC Power Supply (+6V/20A, −6V/5A, +24V/5A, −24V/5A, 200V/ 0,05A)	CPU/2	Grenson	NA	04/71	
N	Power Supply (+6V/20A, −6V/5A, +12V/2A, −12V/2A, +24V/3A, −24V/3A)	CPU/5	Grenson	NA	04/71	
	Power Supply	9001	Nucl. Enterprises	NA	/71	
	Power Unit (+6V/15A, −6V/3A, ±24V/2A, +200V/50mA, 117V)	9022	Nucl. Enterprises	NA	/71	
N	Power Supply	1031	B.L. Packer	NA	02/71	
N	Power Supply Crate	CSAN	RDT	NA	06/71	
	Power Supply	C 301	RDT	NA	10/70	
N	Power Supply	C 303	RDT	NA	06/71	
N	Power Supply Unit (+6V/10A, −6V/2A +24V/1,5A, −24V/1,5A)	P4 ALJ 12	Saphymo-SRAT	NA		
N	Power Supply Unit (+6V/5A, −6V/ 1,5A, 12V/1,5A and 24V/1, 5A both polarities)	P6 ALJ 12	Saphymo-SRAT	NA		
N	Power Supply Unit (+6V/25A, −6V/10A, 12V/3A, 24V/3A both pol., +200/0,1A)	P7 ALJ 13	Saphymo-SRAT	NA		
N	Power Supply (+6V/25A, −6V/10A, +12V/3A, −12V/3A, +24V/3A, −24V/3A, 200V/0,05A)	PS 2036	SEN	NA	06/71	
	Power Pack, 270 VA	1912	Borer	NA	12/69	
N	Supply Module (+6V/6A) (−6V/6A)	CFP/6 CFN/6	Grenson	NA	04/71	

	DESIGNATION + SHORT DATA	TYPE NO.	MANUFACTURER	WIDTH	DELIV.	NPR
	(+12V/3A)	CFP/12				
	(−12V/3A)	CFN/12				
	(+24V/3A)	CFP/24				
	(−24V/3A)	CFN/24				
N	Power unit (for supply Modules)		RO Associates	NA	06/71	
	CAMAC System Power Supply Module (+and −12V/72W or +12V/6A [6A] or +24V/3A)	C 301	RO Associates	NA	03/70	
	CAMAC system power supply module		RO Associates	NA	03/70	
	(6V/10A)	C 210			03/70	
	(6V/5A, 24V/1A)	C 211				
	(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 (incl. module options for 6, 12, and 24V, several currents)	C4 BIP 203	Saphymo-SRAT	NA		
N	Power Supply Module 6V 10A	BIP B 610	Saphymo-SRAT	NA		
	6V 15A	BIP C 615				
	6V 20A	BIP É 620				
	6V 40A	BIP E 640				
	12V 7A	BIP B 127				
	12V 10A	BIP C 1210				
	12V 15A	BIP D 1215				
	12V 25A	BIP E 1225				
	24V 3,5A	BIP B 2435				
	24V 6A	BIP C 246				
	24V 9A	BIP D 249				
	24V 15A	BIP E 2415				
N	Supply Chassis 2kW (Raw supply for regulator modules for 6, 12 and 24 V BPR Ser.)	ALB/10	Saphymo-SRAT	NA		(2)
N	Fan Unit	VALB/10	Saphymo-SRAT	NA		
N	Wired Rack 42U	BC 42	Saphymo-SRAT	NA		(2)
N	Power Supply Module Regulator 6V 5A	BPR 605	Saphymo-SRAT	NA		(2)
	6V 10A	BPR 610				
	6V 25A	BPR 625				
	12V 2A	BPR 122				
	12V 5A	BPR 125				
	24V 3A	BPR 243				
	24V 5A	BPR 245				
	Voltage Regulation Module (both polarities of 6V/9A, 12V/8A, 24V/7A)	1922	Borer	NA	12/69	
	Dual 6V Regulator	1925	Borer	NA	/71	
	Regulator (+/−12V or 24V)	1926	Borer	NA	/71	
	Alarm Unit	1931	Borer	NA	12/69	
	Alarm Unit	1930	Borer	NA	12/69	
	Power Indicator (inserts in special station only)	0704-1	EKCO Instruments Nucl. Enterprises	1		
	Power Indicator	7074-1	EKCO Instruments Nucl. Enterprises	1		
	Supply Monitor Panel	MP 1	GEC-Elliott	NA	01/71	
	Supply Monitor Panel	MP 2	GEC-Elliott	NA	01/71	
	Main Switch	MS 1	GEC-Elliott	NA	01/71	
	Power Unit Crate	0700	EKCO Instruments	NA	01/71	
	Netzteil Chassis (Empty supply chassis)	2.082.000.6	Knürr	NA	10/70	
	Power Supply Crate	CSA	RDT	NA	10/70	

	DESIGNATION + SHORT DATA	TYPE NO.	MANUFACTURER	WIDTH	DELIV.	NPR
VENTILATION EQUIPMENT						
	Luftereinheit (Ventilation unit complete)	2.081.000.6	Knürr	NA	10/70	
	Ventilating Blower Unit (1 fan)	CGV1	RDT	NA	10/70	
	Ventilating Blower Unit (2 fans)	CGV2	RDT	NA	10/70	
N	Fan Unit	VALB/10	Saphymo-SRAT	NA		
	Luftereinheit (Ventilation unit, no fan, no filter)	2.085.000.6	Knürr	NA	10/70	
EXTENDERS AND ADAPTERS						
	Extension Unit	7007-1	EKCO Instruments Nucl. Enterprises	1	/70	
	Module Extender	EF 1	GEC-Elliott	1	01/71	
	Extender Module	11	Jorway	1	01/71	
	Card Extender	2040	LRS/LeCroy	1	08/70	
	Module Extender	ME 2030	SEN	1	03/70	
	Prolongateur pour Tirois CAMAC (Extender)		Transrack	2	17 /70	
	NIM Adaptor	7009-2	EKCO Instruments Nucl. Enterprises	NA	/70	
	Printed Circuit Test Board	10	Jorway	NA	01/71	
	CAMAC NIM Adaptor	CNA 2033	SEN	2	03/71	
N	NIM Adapter	CAN	RDT	NA	06/71	
MODULE PARTS						
	Chassis Kit (Empty module)	7001	EKCO Instruments	1	01/71	
	Chassis Kit (Empty module)	7002	EKCO Instruments	2	01/71	
	Blank Module Kit	BM 1 BM 2 BM 3 BM 4	GEC-Elliott	1 2 3 4	01/71	
	Card Mounting Kit (Empty module) Single Double Triple Quadruple	 BCK/5CAM/CM1 BCK/5CAM/CM2 BCK/5CAM/CM3 BCK/5CAM/CM4	Imhof-Bedco	 1 2 3 4	 06/71	
	Enclosed Bin Kit (Empty module) Double Triple Quadruple	 BCK/5CAM/BM2 BCK/5CAM/BM3 BCK/5CAM/BM4	Imhof-Bedco	 2 3 4	 06/71	
	CAMAC-Kassette (Empty module width 1/25) (2/25) (3/25) (4/25) (5/25) (6/25)	 2 090 001 8 2 090 002 8 2 090 003 8 2 090 004 8 2 090 005 8 2 090 006 8	Knürr	 1 2 3 4 5 6	 10/70	 (2)
	Module Kit (Empty module) (1 unit width) (2 unit width)	 9005-1 9005-2	Nucl. Enterprises	 1 2	 /71 /71	
	Empty Module 1 unit 2 units 3 units 4 units	CCA 1 CCA 2 CCA 3 CCA 4	RDT	1 2 3 4	10/70	

	DESIGNATION + SHORT DATA	TYPE NO.	MANUFACTURER	WIDTH	DELIV.	NPR
	Tiroirs Vides (Empty modules)		SAPEC S.A.	0	01/70	
	Tiroir Modulaire (Empty module)		Transrack			
	(W = 1/25)	TM 50125		1	17/70	
	(W = 2/25)	TM 50225		2		
	(W = 3/25)	TM 50325		3		
	(W = 4/25)	TM 50425		4		
	Tiroir Modulaire (Empty modules 5, 6, 8, 10, and 12 unit widths)	TM 5**25	Transrack	**	07/70	
	Empty Modules		Willsher + Quick	0	01/70	(2)
	Blank Module (Complete with printed board for 69 integrated circuits)	BM 2020	SEN	1	/70	
	Tiroir Modulaire de Commande (Supply control module)	TCM 525	Transrack	1	07/70	
N	General Purpose IC Patchboard (max 33 16-pin and 5 24-pin DIP wire wrap pins)	CAMAC CG 164	GSPK	NA	12/70	(2)
	Experimentierplatte (Printed circuit board)	4.000.002.0	Knürr	0	10/70	
N	Module Printed Circuit Board	CBP	RDT	NA	06/71	
	Controleur Sortie Dataway (Dataway test board)		Transrack	1	07/70	
	Carte Circuit Imprimé CAMAC (Printed circuit board for CAMAC module)		Transrack	NA	07/70	

DATAWAY COMPONENTS

	Dataway Connector		AMP-Holland	NA	10/70	
	Dataway Connector, Flowsolder Termination (Add mounting brackets R500014900000000)	R50001480000000	Carr Fastener	NA	10/70	
	Dataway Connector, Mini Wrap Termination (Add mounting brackets R500014900000000)	R50001680000000	Carr Fastener	NA	10/70	
	Connecteur, Futs Droits (Dataway connector straight pins)	K/47995	FRB Connectron	NA	01/70	
	Connecteur, Futs Wrapping (Dataway connector, wire wrap)	K/48326	FRB Connectron	NA	01/70	
	Connecteur, Futs a Souder (Dataway connector, solder pins)	K/49016	FRB Connectron	NA	01/70	
	CAMAC-Leiste (Dataway connector solder pins)	4.000.001.0	Knürr	NA	10/70	
N	PC Connector Removable Contact (Wire solder contact)	EAA043100	SABCA	NA	06/71	
N	PC Connector Removable Contact (Board solder contact)	EAA043200	SABCA	NA	06/71	
N	PC Connector Removable Contact (wire wrap contact)	EAA043301	SABCA	NA	06/71	(2)
	Connecteur 254 Double Face (Dataway connector, wire wrap)	254 DF 43 AW*V	Socapex	NA	01/70	
	Connecteur 254 Double Face (Dataway connector, motherboard solder)	254 DF 43 AY*V	Socapex	NA	01/70	
	Connecteur Double Face (Dataway connector, wire solder)	254 DF 43 AZ*V	Socapex	NA	01/70	
N	Series 5170 Connector Solder Lugs	10M54630LL43-43	UECL	NA	10/70	
	Mini-Wrap	10M54640LL43-43				
	Flow Solder	10M54632LL43-43				

	DESIGNATION + SHORT DATA	TYPE NO.	MANUFACTURER	WIDTH	DELIV.	NPR
N	Dataway Assembly		MB Metals	NA	07/71	
	Dataway	CDW	RDT	NA	10/70	
N	CAMAC Multilayer (Dataway motherboard)	CM-8-69	Tech. & Tel.	NA	01/70	
BRANCH HIGHWAY COMPONENTS						
	Branch Highway Connector (Fixed member, socket moulding)	WSS0132S00BN000	Emihus SABCA	NA	10/70	
	Branch Highway Connector (Free member, pin moulding, Pxx yyy elects jackscrew)	WSS0132PxxBNyyy	Emihus SABCA	NA	10/70	
	Hood (for free member)	WAC 0132 H005	Emihus SABCA	NA	10/70	
	Branch Highway cable (27cm long)	BHC 027	GEC-Elliott	NA	01/71	
	Branch Highway Cable (xxx cm long)	BHC xxx	GEC-Elliott	NA	01/71	
	Branch Highway Cable (complete cable assembly, 27cm long)	CD 18067-27	Emihus	NA	10/70	
	Branch Highway Cable (complete cable assembly, xxx cm long)	CD 18067-xxx	Emihus	NA	10/70	
N	Branch Cable with connector (1.5 ft long)	1.5 ft long	Jorway	NA	03/71	
	Branch Highway Cables		Precicable Bour	NA	01/70	
N	Branch Highway Cable only (Plain PVC jacket)	66POLB	SABCA	NA	06/71	
N	Branch Highway Cable only (Woven Rilsan jacket)	66 RIL PB	SABCA	NA	06/71	
N	Branch Highway Cable Assembly (27cm cable+connectors)	CC 66 RIL PB-27	SABCA	NA	06/71	
N	Branch Highway Cable Assembly (xx cm long with connectors Rilsan Jacket)	CC 66 RIL PB-xx	SABCA	NA	06/71	
N	Branch Highway Cable Assembly (xx cm long with connectors PVC jacket)	CC 66 POL PB-xx	SABCA	NA	06/71	
OTHER STANDARD CAMAC COMPONENTS						
	Coaxial Connector	RA 00 C50	Lemo	NA	01/70	
N	52-way Double Density Connector (Fixed member with pins, LAM Grader connector)	2 DB 52 P	Cannon	NA	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.

MANUFACTURERS' INDEX

AEG-Telefunken
Elisabethenstrasse 3
Postfach 830
7900 Ulm, Germany

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

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

N CANNON

Carr Fastener Co Ltd
Nottingham Road, Stapleford
Nottingham NG9 8AJ, England

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

Duckert- see Jurgen Duckert

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

EKCO Instruments Ltd.
Southend-on-Sea
Essex SS2 6PS, England

Elliott – See GEC-Elliott

C Emihus Microcomponents Limited
Clive House
12-18 Queens Road, Weybridge
Surrey, England

FRB Connectron
30 Avenue Gabriel Peri
92 Gennevilliers, France

Frieseke und Hoepfner GmbH
Postfach Nr. 72
852 Erlangen-Bruck, Germany

GEC-Elliott Process Instruments Ltd
Century Works, Lewisham
London SE 13, England

C Grenson Electronics Limited
Long March Industrial Estate
High March Road, Daventry
Northants NN11 4HQ England

N G S P K (Electronics) Ltd
Hookstone Park, Harrogate
Yorkshire, England

C Hans Knürr KG
Ampfingstrasse 27
8000 München 8, Germany

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

C Imhof-Bedco Ltd
Ashley Works
Cowley Mill Road, Uxbridge
Middlesex, England

N Interdata Ltd
Station House, Harrow Road
Wembley
Middlesex, England

N J and P Engineering (Reading) Ltd
Portman House
Cardiff Road, Reading
Berkshire RG1-8JF, England

Jorway Corporation
27 Bond Street, Westbury
New York 11590, USA

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

Knürr – see Hans Knürr

LeCroy Research Systems Corp.
126 North Route 303, West Nyack
New York 10994, USA

Lemo SA
1110 Morges, Switzerland

LRS/LeCroy see LeCroy Research
Systems Corp

N MB Metals Ltd.
Portlade
Sussex, England

N Micro Consultants Limited
Interface House
Croydon Road, Caterham
Surrey, England

C Nuclear Enterprises Limited
Bath Road, Beenham
Reading RG 7 5PR, England

Nuclear Measurements
A Division of EG+G Nuclear Ltd
Dalroad Industrial Estate
Dallow Road, Luton
Bedfordshire, England

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

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

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

C RO Associates Incorporated
3705 Haven Avenue, Menlo Park
California 94025, USA

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

SAIP-CRC – see Schlumberger

SAPEG S.A.
Société Anonyme pour Electronique
Geneve
7, Avenue Krieg
1208 Genève, Switzerland

C Saphymo-SRAT
51, Rue de l'Amiral-Mouchez
75-Paris 13e, France

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

SEN Electronique
31, Avenue Ernest-Pictet
1211 Geneve 13, Switzerland

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

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

N Technograph and Telegraph Limited
Fleet, Aldershot
Hampshire, England

Telefunken – See AEG-Telefunken

N Texas Instruments Ltd
Dallas Road
Bedford, England

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

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

Willsher and Quick Ltd
Walrow, Highbridge
Somerset, England

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	*M. Sarquiz**	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

•The ESONE Committee has recently admitted these laboratories to full membership. There are now 34 member organisations.