CAMAC
bulletin

A publication
of the
ESONE Committee

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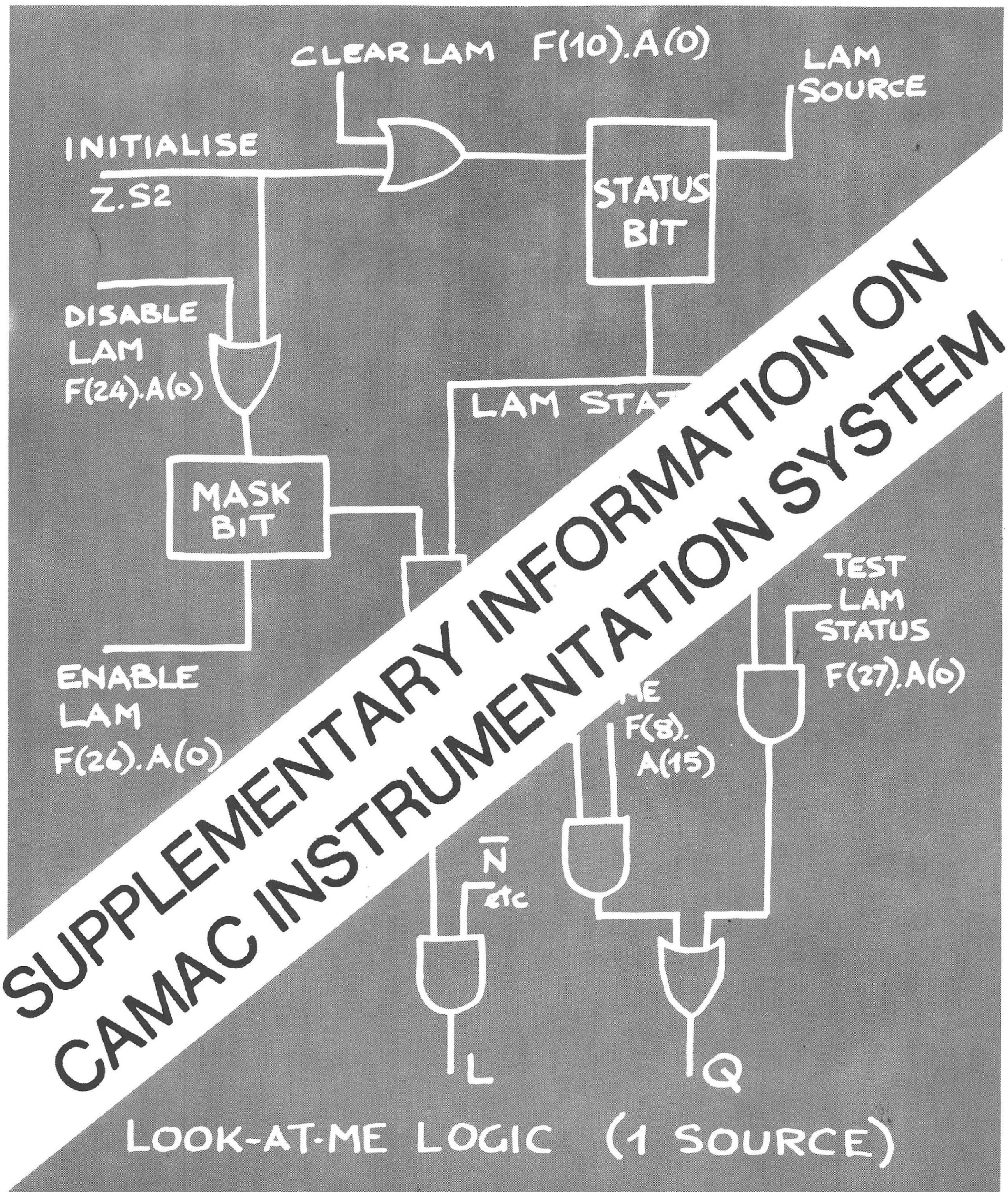
Supplement



PREFACE

The ESONE Committee has for some time recognised the need for additional documents providing authoritative information on the practical interpretation of the CAMAC specifications.

This document has been prepared by Working Groups of the USAEC NIM Committee, in collaboration with the appropriate Working Groups of the ESONE Committee. It is endorsed by the ESONE Committee on the mutual understanding that it contains supplementary information, and does not modify or extend the formal specifications.

When necessary, this supplementary information may be updated and extended. Announcements concerning such changes will be published in CAMAC Bulletin.

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ZWEITES INTERNATIONALES SYMPOSIUM UBER
CAMAC
FUR DATENVERARBEITUNGSANWENDUNGEN
Brüssel, 14-16 Oktober 1975

SECOND INTERNATIONAL SYMPOSIUM ON
CAMAC
IN COMPUTER APPLICATIONS
Brussel, 14-16 October, 1975

DEUXIEME SYMPOSIUM INTERNATIONAL
CAMAC
DANS LES SYSTEMES INFORMATIQUES
Bruxelles, 14-16 octobre, 1975

Veranstalted von / Organized by / Organisé par :

ESONE Komitee
ESONE Committee
Comité ESONE

in Zusammenarbeit mit / in collaboration with / en collaboration avec :

Europäische CAMAC Vereinigung
European CAMAC Association
Association Européenne CAMAC

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KOMMISSION DER EUROPAISCHEN GEMEINSCHAFTEN (KEG)
COMMISSION OF THE EUROPEAN COMMUNITIES (CEC)
COMMISSION DES COMMUNAUTES EUROPEENNES (CCE)

April 1975

SECOND INTERNATIONAL SYMPOSIUM ON
CAMAC
IN COMPUTER APPLICATIONS
Brussels, October 14-16,1975
Latest Information on the detailed Programme

SESSION I
9.30h, Tuesday, October 14, 1975

Opening

Opening Speeches by Officials of the Commission of the European Communities and Representatives of the ESONE Committee and the European CAMAC Association

Status of CAMAC Applications

Status of CAMAC :

- In Western Europe
  H. Bisby, Harwell, Great Britain
- In Eastern Europe
  B. Fefilov, Dubna, USSR, J. Lukacs, Budapest, Hungary, R. Trechcinsky, Warsaw, Poland
- In North America
  D. Horelick, R. Larsen, Stanford, USA

SESSION II
14.30h, Tuesday, October 14, 1975
(two parallel Sessions)

Session II.1 Introduction to CAMAC

- CAMAC Hardware
  H. Stuckenberg, DESY Hamburg, F.R. Germany
- CAMAC Software
  I. Pyle, University of York, Great Britain
- CAMAC System Configurations
  H. Klessmann, HMI Berlin, F.R. Germany

Session II.2. CAMAC Developments

- An Implementation of IML-B I for the PDP-11 (a BASIC Extension for Real-Time CAMAC Systems)
  G. Bianchi, CEN Saclay, France,
  A. Lewis, AERE Harwell, Great Britain
- A New Version of the CAMAC Extended BASIC Language
  Ho-Xich-Tue, J. Servent, Schlumberger, Bagneux, France
- Macro-IML Implementation for the DEC PDP-11 Computer
  M. Kubitz, R. Kind, HMI Berlin, F.R. Germany
- A Multiuser CAMAC Handler for a PDP-11/45 System
  D. Hammer, G. Janzek, G. Schmitt, Technical University Vienna, Austria
- Ensemble d' analyse automatique de chassis à microprocesseur incorporé
  J. Kaiser, CEN Saclay, France
- Real-Time and Autonomous Microprocessing in large CAMAC Systems
  M. Collins, C. Guillaume, R. Rausch, CERN, Geneva, Switzerland
- CMC 8080 : CAMAC Crate Controller with Microcomputer INTEL 8080
  E. Schöberl, SGAE, Seibersdorf, Austria
- The Application of a Modular System Controller Concept to the Development of Advanced Data Acquisition and Control Systems in CAMAC
  D. Drury, GEC Elliott, Leicester, Great Britain
- The Design of CAMAC Controllers with Software in Mind
  F. Goulding, Applied Computer Systems Ltd., Manchester, Great Britain
- Memoire a tores, type CAMAC 200
  J. Dernalowicz, G. Dzwonnik, W. Jarosinski, A. Wolowski, Académie Polonaise des Sciences, Warszawa, Poland
- FORTRAN/BASIC Subroutines for CAMAC on NOVA-2 Computers
  G. Ehret, W. Karbstein, W. Kneis, GfK Karlsruhe, F.R. Germany (by title only)
- A CAMAC-Oriented Multitasking Supervisor for PDP-11 Computer
  H. Kirkman, Daresbury Laboratory Great Britain (by title only)
- Alphanumeric and Histogram Direct Display
  F. Hübler, A. Krolzig, DESY Hamburg, F.R. Germany (by title only)
- An Alpha-Numeric and Graphics Display Facility in CAMAC
  N. Toy, GEC Elliott, Leicester, Great Britain (by title only)
- A Standard Interface Port for CAMAC
  G. McPherson, Rutherford Laboratory, Chilton, Great Britain (by title only)

SESSION III
9.00h Wednesday, October 15, 1975

Survey of CAMAC Applications in :

- Industrial Process Control
  L. Kingham, CERL, Leatherhead, Great Britain
- Laboratory Automation
  R. Patzelt, Technical University, Vienna, Austria
- Medicine and Health Services
  H. Pangritz, HMI Berlin, F.R. Germany

SESSION IV
14.30h Wednesday, October 15, 1975
(three parallel Sessions)

Session IV.1. Industrial Process Control

- The Application of CAMAC to the Instrumentation of Mine Ore Milling Circuits
  W. Gertenbach, Atomic Energy Board, Pretoria, South Africa

- An Instrumentation for Control and Measurement of Activated Mineral Samples
  P. Skaarup, Research Establishment Risö, Denmark
- Application of a Standardized Process-Peripheral System(CAMAC) for Direct Numerical Control of Machine Tools
  K. Zwoll, KFA Jülich, K. Zenner, R. Möhl, RWTH-Aachen, F. R. Germany
- Einzatz von CAMAC auf Motorenprüfständen
  P. Claassen, AVL, Graz, Austria
- Computer Control in Glass Manufacturing
  G. Vasheggi et al, KFKI, Budapest, Hungary
- CAMAC for Automated Warehouses
  R. Thiel, Borer A. G., Solothurn, Switzerland
- Testing Real-Time Peripherals at Run-Time
  R. Lauber, University of Stuttgart, M. Mall Dornier System, F. R. Germany
- Localisation automatique des ruptures de gaine sur une centrale nucléaire rapide
  M. Argouarch, Technicatome, MM. Hagemann, Lohez, Titchenko, CEN Saclay, MM. Peirano, Viers, CEN Cadarache, France(by title only)
- Mobile Laboratory Equipped with a Control Computer
  S. Chladek, INORGA, Prague, Czechoslovakia (by title only)
- CAMAC in the Multi-User Data Logging Environment
  A. Burley, Nuclear Enterprises Ltd., Beenham, Great Britain(by title only)
- The Testing of CAMAC Modules-A Description of Current Industrial Practice
  D. Drury, GEC Elliott, Leicester, Great Britain(by title only)
- The Wiring Tester
  F. Wagner, Politechnika Slaska, Gliwice, Poland(by title only)

Session IV. 2. Laboratory Automation I.

- Quartz Crystal Controlled and Angle Regulated Drive System
  J. Räbiger, W. Schalt, A. Seegers, KFA Jülich, F. R. Germany
- A CAMAC Multiparameter Data Acquisition System
  J. Bialkowski, S. Hultberg, A. Lang, J. Sztarkier, Research Institute for Physics, Stockholm, Sweden
- Automation of Two Physical Experiments by a Multiuser CAMAC System
  R. Grössinger, D. Hammer, G. Janzek, W. Seelos, P. Staub, Technical University Vienna, Austria
- The Use of CAMAC in a Multiprogramming Operating System for High Energy Physics Experiments
  R. Hand, D. Maden, D. Quarrie, Rutherford Laboratory, Chilton, Great Britain
- Analyseur de hauteur d'impulsion en temps réel multitaches
  F. Worm, SEN, Genève, Switzerland
- The Kelvin Laboratory Data Analysis and Display System
  A. Coales, A. Slight, A. Wilkinson, Glasgow, Great Britain
- A CAMAC System for Accelerator Control
  M. Cawthraw, R. Downs, Rutherford Laboratory, Chilton, Great Britain
- A Multiparameter Nuclear Data Acquisition System
  S. Tagesen, Institute for Radium Research and Nuclear Physics, Vienna, Austria(by title only)
- Minicomputer Control of Radiation Calibration Facility
  B. Bjarland, Institute of Radiation Physics, Helsinki, Finland(by title only)
- Automatic Inspection of Nuclear Fuel Elements Using CAMAC and PDP-11
  J. Bundgaard, P. Christensen, Research Establishment Risö, Denmark (by title only)
- Stand-Alone Laboratory Instrumentation in CAMAC
  G. Erdélyi, I. Hernyes, J. Koch, L. Lohonyai, I. Naday, T. Sandor, I. Szücs, P. Turmezei, J. Windberg, A. Zarandy, KFKI, Budapest, Hungary (by title only)

Session IV. 3. Medicine and Health Services

- A Radiation Beam Scanner
  I. Uotila, Institute of Radiation Safety, Helsinki, Finland
- Rectilinear Scanner Interfacing in Nuclear Medicine Using CAMAC
  J. Böhm, J. Snajder, M. Tiringer, University of Ljubljana, Yugoslavia
- A CAMAC System for Acquisition and Interactive Evaluation of Scintigraphic Data
  V. Schmidt et al, HMI Berlin, F. R. Germany
- Implementation and Testing of a CAMAC System for Intensive Care
  E. Rehse et al, University of Düsseldorf, F. R. Germany
- Design Considerations for Functional CAMAC Modules in Bio-Medical Field
  N. Blasovszky, KFKI, Budapest, Hungary
- A CAMAC-Integrated EKG-Amplifier
  M. Krämer, University of Düsseldorf, F. R. Germany
- Automatisation Prospects of the Acquisition and Treatment of Data in the Study of Visual Processes in Neuropsychology
  F. Chain, G. Deloche, Hôpital de la Salpêtrière, Paris, France

- The Use of a CAMAC System in Nuclear Medicine Research and Routine Work
  N. Brown, Middlesex Hospital, Medical School, London, Great Britain
  (by title only)

SESSION V
9.00h Thursday, October 16, 1975

Survey of CAMAC Applications in :

- Data and Computer Communication
  B. Zacharov, DNPL, Daresbury, Great Britain
- Public Utilities
  H. Lukacs, KFKI, Budapest, Hungary
- Environmental Control
  H. Landbrecht, Bureau for Environmental Protection, Munich, F. R. Germany

SESSION VI
14.30h Thursday, October 16, 1975
(three parallel Sessions)

Session VI. 1. Environmental Control, Public Utilities, Astronomy, Education

- Environmental Control-Measurement of the Quality of Air and Water, Water Level, Noise and Radioactivity
  W. Branke, Dornier System, F. R. Germany
- Data Acquisition and Process Control at Electric Power Plants
  W. Czygrinow, Institute of Power Systems Automation, Wroclaw, Poland
- A Passenger Lift Traffic Pattern Analyser
  K. Smith, GEC Elliott, Leicester, Great Britain
- The Use of CAMAC in Astronomy
  C. Stephens, Imperial College, London, Great Britain
- Use of CAMAC in Teaching Computer Science at University
  I. Pyle, University of York, Great Britain
- Messdatenerfassung mittels Prozess-rechnereinheit CAMAC–PDP-11/20
  D. Filbert, Technische Universität, Berlin, F. R. Germany (by title only)

Session VI. 2. Laboratory Automation II

- Laboratory Automation at the Daresbury Synchrotron Radiation Facility
  P. Clout, P. Ridley, DNPL, Daresbury, Great Britain
- Ein CAMAC-System zur Zelldatener-fassung mit dem Prozessrechner SIEMENS 330
  P. Gais, Institut für Strahlenschutz, München, F. R. Germany
- Laborautomation dargestellt am Beispiel eines Experiments zur Bestimmung spezifischer Wärmen bei tiefen Temperaturen
  M. Schürlein, IDAS, Limburg/Lahn, F. R. Germany
- Laborautomatisierung in Klinisch-Chemischen Labors der Dr. Karl Thomae GmbH
  R. Schäfer, C. H. Boehringer Sohn, Ingelheim, F. R. Germany
- A Fast CAMAC Based Data Acquisition and Processing System for a Local Boiling Experiment in Sodium
  P. v. d. Berg[(+)], C. Frumau, A. Overtoom, R. C. N. Petten, Netherlands
- A CAMAC Based Dual Computer System for Process Control and Evaluation of Experimental Data
  B. Gliss, MPI, Stuttgart, F. R. Germany
  (by title only)

Session VI. 3. Data and Computer Communication, Accelerator Control

- Use of CAMAC in Satellite Control and Test Stations
  A. Popp, Dornier System, F. R. Germany
- Connection of an Intelligent Subsystem by the CAMAC Serial Highway
  R. Conway, H. Halling, KFA Jülich, F. R. Germany
- On-Line Computer Control of the CERN Intersecting Storage Rings
  H. Verelst, M. Vignes, P. Wolstenholme, CERN, Geneva, Switzerland
- A Camac Serial Highway Instrumentation System for Process Control of the VICKSI Accelerator
  W. Busse, G. Herdam, H. Klessmann, H. Kluge, M. Martini, W. Wawer, HMI Berlin, F. R. Germany
- Computer Aided Operation of the Karlsruhe Isochronous Cyclotron Using CAMAC
  W. Kappel, W. Karbstein, W. Kneis, J. Möllenbeck, H. Schweickert, B. Volk, GfK Karlsruhe, F. R. Germany
- 'CAMPUTER' Intelligent Subsystem in CAMAC
  H. Liebendörfer, Borer AG, Solothurn, Switzerland (by title only)

CLOSING SESSION
17.30h Thursday, October 16, 1975

- CAMAC-Future Prospects
  K. Zander, HMI Berlin, F. R. Germany
- Closure

End of Symposium

Supplement to
CAMAC Bulletin No. 6

CAMAC

SUPPLEMENTARY INFORMATION ON CAMAC INSTRUMENTATION SYSTEM

Reprinted from USAEC Report TID-25877

ABSTRACT

This report contains supplementary information to be used in conjunction with EUR 4100e, 1972, which describes the CAMAC modular instrumentation system for data handling, and EUR 4600e, 1972, which defines a CAMAC branch highway and crate controller. Included are recommendations concerning the implementation and interpretation of the specifications, and descriptions of preferred practices and current applications. This report does not modify the specifications referred to above.

USE IN CONJUNCTION WITH

Title	*EURATOM Report No.*	*AEC Report No.*
CAMAC–A Modular Instrumentation System for Data Handling, Revised Description and Specification	EUR 4100e (1972)	TID-25875
CAMAC–Organization of Multi-Crate Systems. Specification of the Branch Highway and CAMAC Crate Controller Type A	EUR 4600e (1972)	TID-25876

ESONE COMMITTEE **November 1972**

CONTENTS

A. INTRODUCTION

The CAMAC modular instrumentation system for data handling has been developed by the ESONE Committee of European Laboratories and endorsed by the U.S. AEC NIM Committee. Throughout the development of CAMAC there has been constant collaboration and interchange of views and information between the NIM Committee and ESONE. This has helped assure that CAMAC would meet both European and North American needs.

B. PURPOSE OF REPORT AND REVISIONS

This report makes recommendations concerning the implementation and interpretation of the specifications and includes descriptions of preferred practices and current applications. It is to be used in conjunction with AEC Reports TID-25875 and TID-25876 (EUR 4100e, 1972 and EUR 4600e, 1972, respectively) but does not modify them. It is intended to update and reissue this report from time to time, as necessary. Users are urged to ascertain that they have the latest issue. When necessary, addenda will also be issued.

During the preparation of this report, it has been critically reviewed by the ESONE Dataway Working Group and incorporates its many contributions.

C. APPROVAL OF REPORT

This report has the approval of both the NIM and ESONE Committees.

D. SECTION DESIGNATIONS AND REFERENCES

The designations of the sections in this report refer to the most pertinent sections in AEC Reports TID-25875 and TID-25876 (EUR 4100e, 1972 and EUR 4600e, 1972, respectively), with the prefix K referring to TID-25875 (EUR 4100e) and the prefix L to TID-25876 (EUR 4600e). For example, K4.2.2b is the second item in this report to which Section 4.2.2 of TID-25875 (EUR 4100e) is particularly pertinent. Similarly, for Section L3a, Section 3 of TID-25876 (EUR 4600e) is especially pertinent. In addition, related sections of TID-25875 (EUR 4100e) and TID-25876 (EUR 4600e) are listed to the right of each section, where applicable.

E. NIM COMMITTEE ORGANIZATION

Institutions having respresentatives on the NIM Committee are listed below. The detailed representation is given in Appendix A. The NIM Committee includes also NIM-CAMAC working groups as listed in Appendix B.

- Argonne National Laboratory
- Atomic Energy of Canada, Ltd.
- Brookhaven National Laboratory
- CERN European Organization for Nuclear Research
- Columbia University
- Hanford Engineering Development Laboratory
- Lawrence Berkeley Laboratory
- Lawrence Livermore Laboratory
- Los Alamos Scientific Laboratory
- National Accelerator Laboratory
- National Aeronautics and Space Administration (GSFC)
- Oak Ridge National Laboratory
- Pacific Northwest Laboratory
- Stanford Linear Accelerator Center
- TRIUMF, British Columbia, Canada
- U.S. AEC Health and Safety Laboratory
- U.S. Atomic Energy Commission
- U.S. National Bureau of Standards
- Yale University

Participating laboratories also include:

- Florida State University
- Kitt Peak National Observatory
- Lick Observatory

F. ESONE COMMITTEE ORGANIZATION

Countries and international organizations having representatives on the ESONE Committee are listed below. The detailed representation is given in Appendix C. The ESONE Committee also includes working groups as listed in Appendix D.

Austria	Germany	Poland
Belgium	Greece	Sweden
Canada	Hungary	Switzerland
Denmark	Italy	United Kingdom
France	Netherlands	Yugoslavia

European Organization for Nuclear Research (CERN)
Commission of the European Communities (EURATOM)

G. INFORMATION AND MAILING LIST

Those desiring information or who wish to be placed on the NIM-CAMAC mailing list so as to receive addenda and supplements issued by the NIM Committee, and to be kept current on NIM-CAMAC matters, should write to:

Louis Costrell, Chairman
NIM Committee
Radiation Physics Bldg.
National Bureau of Standards
Washington, D. C. 20234

In Europe, information regarding CAMAC can be obtained from:

W. Becker, Secretary
ESONE Committee
C.C.R. Euratom
I-21020 Ispra (VA)
Italy

H. DRAWINGS

Reduced size copies of the CAMAC drawings are included in the reports. It is anticipated that these small scale drawings will be adequate for the many users and for those whose only CAMAC construction consists of building circuits into CAMAC plug-in units that have been procured elsewhere. However, large scale copies of some of the drawings will be useful to manufacturers of crates and plug-in units. Those desiring large scale drawings should write to the Chairman of the NIM Committee or the Secretary of the ESONE Committee (See Section G). The large scale drawings will be kept current with regard to corrections and modifications. Users are cautioned to ascertain that they are working with the latest revisions of all drawings. The CAMAC drawings that constitute part of the CAMAC reports are listed below:

Fig. # in TID-25875 EUR 4100e	Fig. # in TID-25876 EUR 4600e	ESONE Drawing Number	NIM Drawing Number	Title
-	-	CA-600	NA-600	Drawing List
1	-	CD-601	ND-601	Unventilated Crate - Front View
2	-	CD-602	ND-602	Plan View of Lower Guides in Crate
3	-	CD-603	ND-603	Crate - Side View, Section
4	-	CD-604	ND-604	Plug-in Unit - Side and Rear Views
5	-	CD-605	ND-605	Dataway Connector
6	-	CD-606	ND-606	Ventilated Crate - Front View
7	-	CD-607	ND-607	Adaptor for NIM Units
8	-	CD-608	ND-608	Typical Printed Wiring Card
-	7	CD-609	ND-609	CAMAC Crate Controller Type A
-	-	CD-549	ND-549	NIM-CAMAC Coaxial Connectors Type 50CM

K1a. Compatibility Aspects of CAMAC Revisions

References
TID-25875 EUR 4100e, 1972 Section 1 TID-25876 EUR 4600e, 1972 Section 1

The 1972 CAMAC specifications include a number of changes from the original version. The significant changes are indicated by vertical lines in the left-hand margins of the 1972 specifications, TID-25875 (EUR 4100e, 1972). TID-25876 (EUR 4600e, 1972) represents the first fully approved Branch Highway specification. However, some equipment has been built based on preliminary versions that differ in some respect from the specification as finally approved. A summary of these differences is given in Appendix G. As stated in Section 1 of TID-25875 (EUR 4100e):

> "(The changes) have been specified in such a way that equipment conforming to this revised document can generally be used in association with older equipment, although under such conditions it may not be possible to derive the full benefit from new features."

However, in intermixing 1969 and 1972 type modules, caution must be exercised in some instances, particularly with regard to former patch pins P1 and P2 and the Command Accepted X line.

P1 and P2 were previously patch pins freely available for local connections. They remain in that category for the control station but are now bussed as "free busses" across all the normal stations. Therefore, older modules using P1 or P2 as patch connections may require rewiring in that respect if used in new or updated crates.

The Reserved X line of the 1969 version has been designated "Command Accepted." The 1969 type modules do not have provision for generating a Command Accepted response. They can be used in 1972 version systems by defeating the Command Accepted requirement (see L4.2.3) or, where this represents a sacrifice insofar as the rest of the installation is concerned, a pseudo response can be obtained by a simple additional circuit within the module which makes X=N.

The Crate Controller Type A-1 has provision for Command Accepted (X) signals whereas the Type A of earlier drafts did not.

The Function Codes F(18) and F(19) have been redefined in a manner that makes them incompatible with the older definitions. This redefinition was feasible because there has been very little use of these Function Codes in older modules.

Appendix F of this report examines the significant specification changes point by point, particularly with regard to the compatibility aspects.

K4.1.1a. Crate Jig

References
TID-25875 EUR 4100e, 1972 Section 4.1.1

Figure K4.1.1a shows an example of a jig used in a number of U.S. laboratories for checking some minimum tolerance dimensions and the location of Dataway connectors and fixing screw holes.

Note: Construction details are given in Lawrence Berkeley Laboratory Drawing 11X7441 P-2.

Lawrence Berkeley Laboratory drawings are available from D. A. Mack, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720

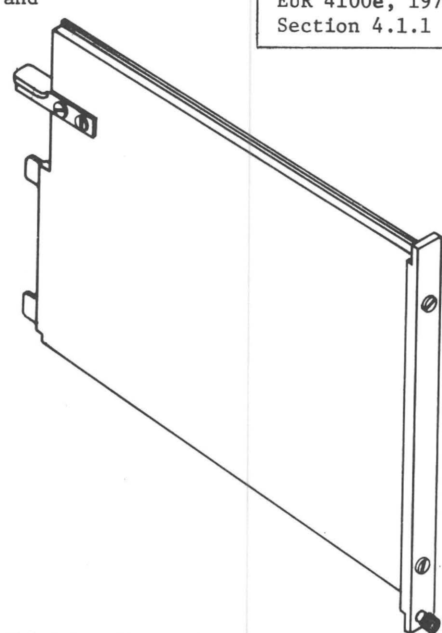


Fig. K4.1.1a. Example of Crate Jig

K4.1.1b. **Crate** Rear Construction

The design of the rear of the crate should be such as to protect the Dataway from damage. At the same time, in the space above the Dataway, access must be provided to the rear of the plug-in units. Figure E5 of Appendix E illustrates an interface housing unit to provide this protection and to readily accomodate a power supply such as the Type CP-1.

References
TID-25875 EUR 4100e, 1972 Section 4.1.1 and Figures 2 & 3

K4.1.1c. Reference to Specification for Panel Dimensions

The fourth paragraph of 4.1.1 of TID-25875 (EUR 4100e) refers to IEC 45(Central Office)24. This Central Office Document was a preliminary document of the International Electrotechnical Commission and has been superseded by IEC Publication 297.

References
TID-25875 EUR 4100e, 1972 Section 4.1.1

K4.2.1a. Plug-in Unit Assemblies

An example of a shielded plug-in unit is shown in Figure K4.2.1a. Detailed drawings of plug-in units are available from:

Lawrence Berkeley Laboratory (See note in K4.1.1a) -
-LBL Drawing 11X7054 A5

and

European Organization for Nuclear Research (CERN)
J. Halon, NP Division
1211 Geneva 23
Switzerland
-CERN Report CIM 25543

References
TID-25875 EUR 4100e, 1972 Sections 4.2.1 4.2.2

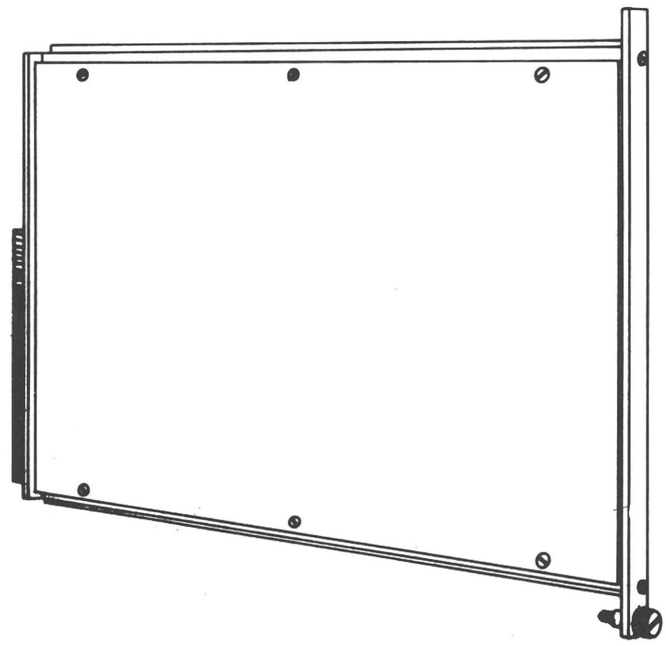


Fig. K4.2.1a. Example of Shielded Plug-in Unit

K4.2.2a. Chamfer of Dataway Connector Plug for Plug-in Unit

TID-25875 (EUR 4100e) specifies maximum chamfers of 1mm x 1mm for top and bottom corners of the plug-in unit Dataway connector plug. A chamfer of approximately 0.1mm x 0.1mm (which is consistent with the specifications) is preferred to further reduce the possibility of momentary mismating of the edge connector with the Dataway connector. Mismating can result in destruction of the circuits when plug-in units are inserted in energized crates. It will be noted that the Dataway connector socket includes an entrance ramp.

References
TID-25875 EUR 4100e, 1972 Section 4.2.2 and Figure 5

K4.2.2b Typical Dataway Connector Plug for Plug-in Units

References
TID-25875 EUR 4100e, 1972 Section 4.2.2 & Figures 5, 7 & 8

Figure 4.2.2b shows details of a typical Dataway connector plug derived from Figures 5.1, 5.2, 5.3, 7 and 8 of TID-25875 (EUR 4100e)

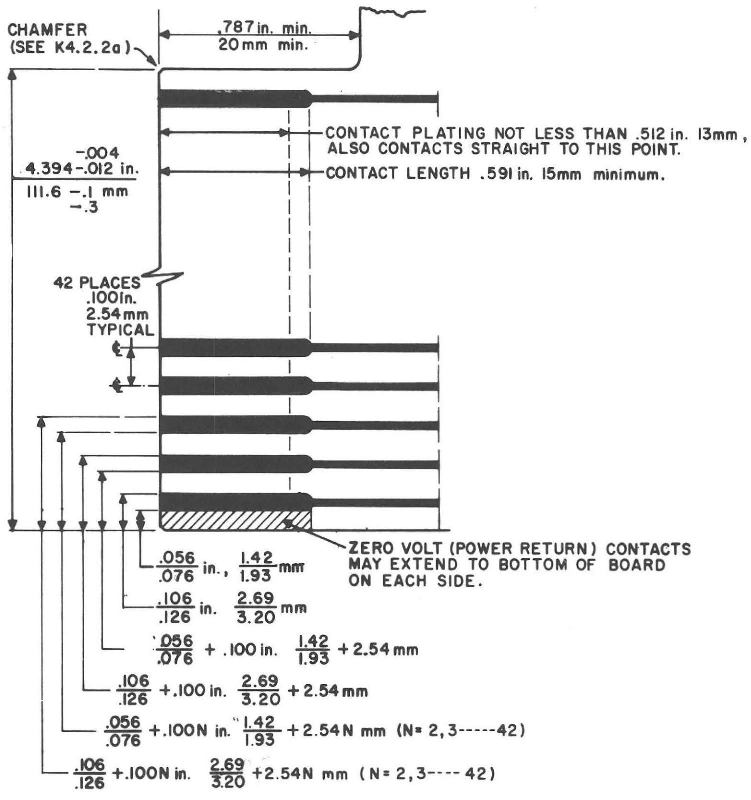


Fig. K4.2.2b. Typical Dataway Connector Plug

K4.2.5a Coaxial Connector

References
TID-25875 EUR 4100e, 1972 Section 4.2.5

The coaxial connector strongly recommended in Section 4.2.5 of TID-25875 (EUR 4100e) is now specified as NIM-CAMAC Type 50CM in accordance with NIM DRAWING ND-549 (ESONE Drawing CD-549). Examples include the LEMO 00C50 series and the KINGS K-Loc series.

Note: If instances are encountered where such connectors produced prior to the adoption of this drawing do not fully mate, the problem can be eliminated by filing about 0.2 mm from the mating end of the plug.

K4.2.5b Auxiliary Connectors

References
TID-25875 EUR 4100e, 1972 Section 4.2.5

Preferred auxiliary connectors are designated for communicating from and to plug-in units. They may be mounted on the front panel or in the restricted space on the rear of plug-in units. Table K4.2.5b-1 lists the auxiliary connectors; the use of the locking assemblies is also recommended. The contact arrangements are shown in Figures K4.2.5b-1, -2 and -3. The fixed connector is preferably mounted with pin 1 at the bottom.

When used for balanced or unbalanced signal transmission lines, it is recommended that the signal pairs be assigned as shown in Table K4.2.5b-2. RETURN is to be used as the complement of SIGNAL for a balanced pair, or as the ground reference for an unbalanced pair. The recommended location of the common ground, and also of Vcc, if used, is in the Table. The contact assignments for the 52-pin and 88-pin connectors have been made to facilitate the use of ribbon cables.

Cables assemblies consisting of multiple twisted-pairs of conductors can be made with individual twisted pairs assigned to pins as shown in the Table. The same cable assemblies can also be used where individual signals of a group are each carried on a single conductor, with a common ground return for the group. Cable assemblies made in conformance with these recommendations should be differentiated from other, outwardly similar, cables with the marking "K4.2." This marking indicates to the user that the cable contains only twisted pairs, with pairs connected to all pins as shown in Table K4.2.5b-2.

Table K4.2.5b-I. Preferred Auxiliary Connectors

Original Manufacturer	ITT Cannon Electric	Hughes Aircraft Company	
Connector Type	2D Subminiature Rectangular Connector	WSS Subminiature Rectangular Connector	
Number of Contacts	52	88	132
Polarizing Code	-		BN
Useable on	Front or rear panels, all widths	Front panels, all widths	Front panels down to double width
Catalog Numbers			
Fixed member (Chassis connector)	2DB52P Pin Housing	WSS 0088 S00 BN00 Socket Housing	WSS 0132 S00 BN00 Socket Housing
Locking assembly	D20418-2		
Free member (Cable connector)	2DB52S Socket Housing	WSS 0088 Pxx BNyyy* Pin Housing	WSS 0132 Pxx BNyyy* Pin Housing
Cable hood	DB24659	WAC 0088 H005 for example	WAC 0132 H005 for example
Locking assembly	D20419		

*Pxx yyy denotes type of jack screw

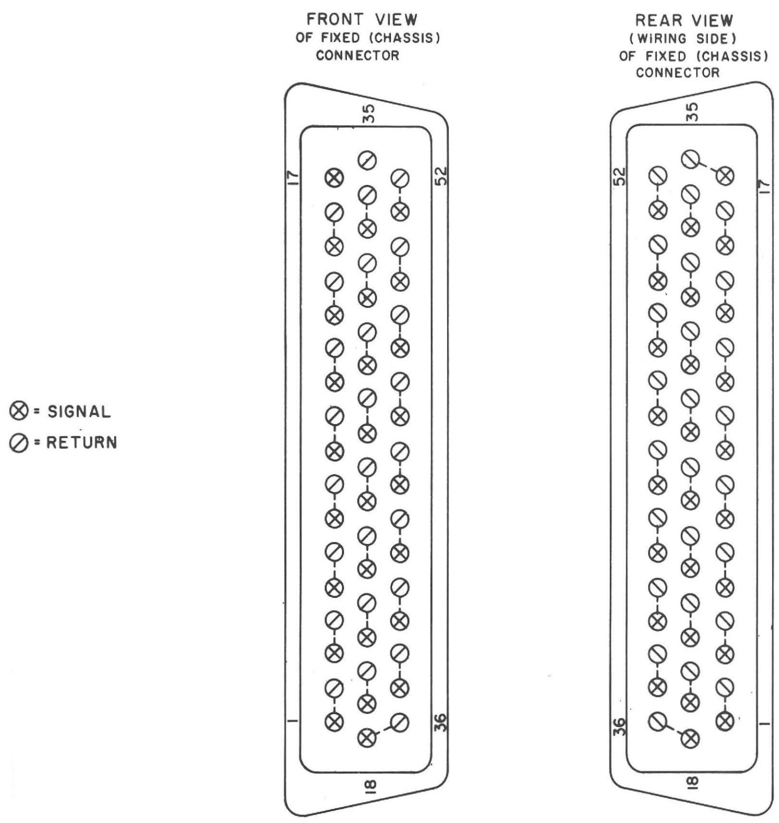


Fig. K4.2.5b-I. Contact Arrangement for Preferred 52-Pin Auxiliary Connector

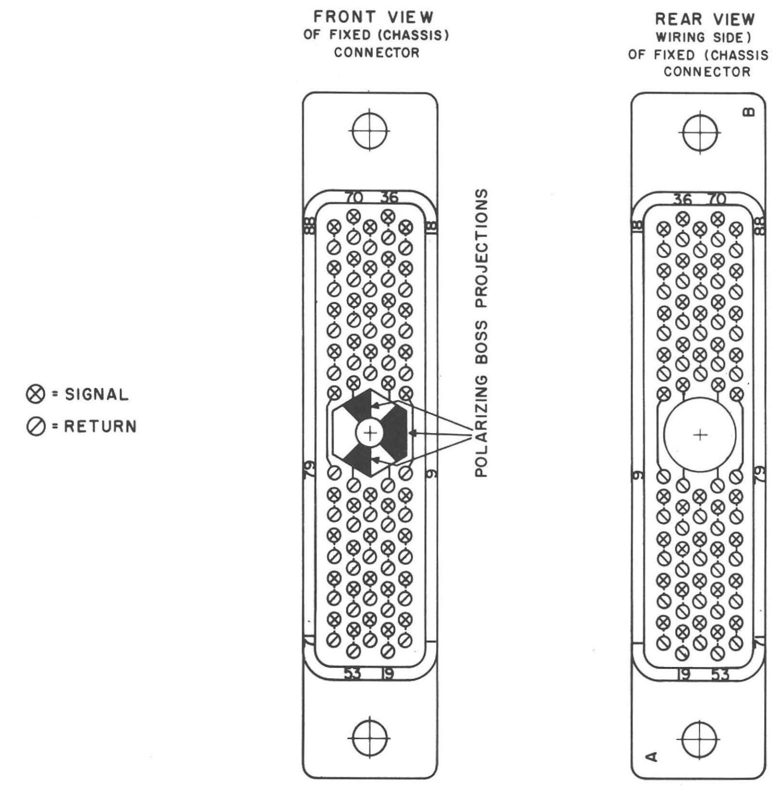


Fig. K4.2.5b-2. Contact Arrangement for Preferred 88-Pin Auxiliary Connector

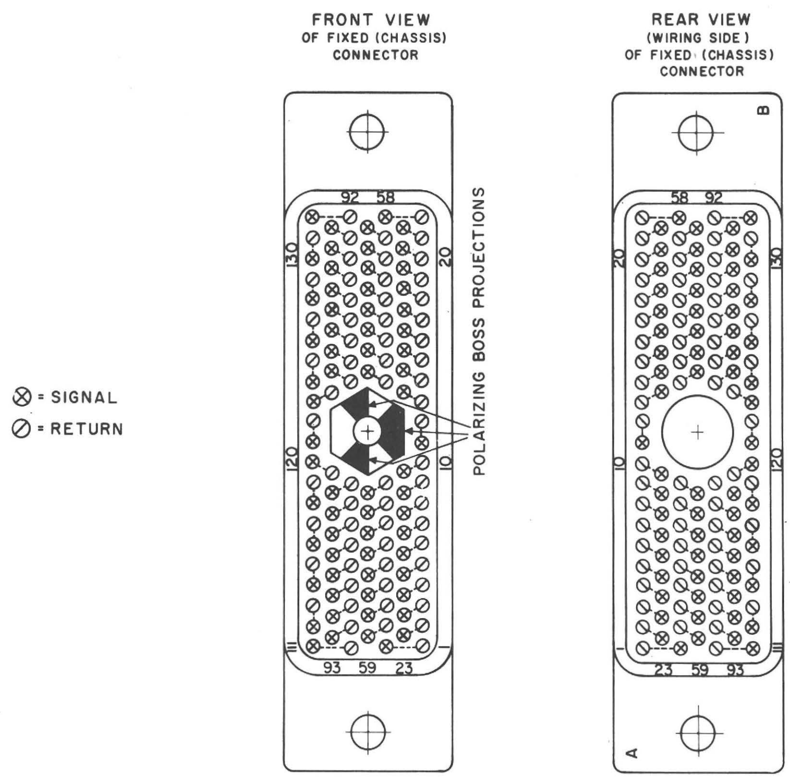


Fig. K4.2.5b-3. Contact Arrangement for Preferred 132-Pin Auxiliary Connector

Fig. K4.2.5b-1. Contact Arrangement for Preferred 52-Pin Auxiliary Connector

PAIR NO.	52-Pin Cannon		88-Pin Hughes		132-Pin Hughes	
	Signal Contact	Return Contact	Signal Contact	Return Contact	Signal Contact	Return Contact
1	1	2	2	1	41	1
2	3	4	4	3	23	2
3	5	6	6	5	24	3
4	7	8	8	7	25	4
5	9	10	10	9	26	5
6	11	12	12	11	27	6
7	13	14	14	13	28	7
8	15	16	16	15	29	8
9	17	35	18	17	30	9
10	18	36	20	19	31	10
11	19	20	22	21	11	12
12	21	22	24	23	32	13
13	23	24	26	25	33	14
14	25	26	28	27	34	15
15	27	28	30	29	35	16
16	29	30	32	31	36	17
17	31	32	34	33	37	18
18	33	34	36	35	38	19
19	37	38	38	37	39	20
20	39	40	40	39	40	21
21	41	42	42	41	58	22
22	43	44	44	43	59	42
23	45	46	46	45	60	43
24	47	48	48	47	61	44
25	49	50	50	49	62	45
26	51	52	52	51	63	46
27			54	53	64	47
28			56	55	65	48
29			58	57	66	49
30			60	59	67	50
31			62	61	68	51
32			64	63	69	52
33			66	65	70	53
34			68	67	71	54
35			70	69	72	55
36			72	71	73	56
37			74	73	74	57
38			76	75	93	76
39			78	77	94	77
40			80	79	95	78
41			82	81	96	79
42			84	83	97	80
43			86	85	98	81
44			88	87	99	82
45					100	83
46					103	84
47					104	85
48					105	86
49					106	87
50					107	88
51					108	89
52					109	90
53					110	91
54					111	75
55					112	113
56					114	115
57					116	117
58					118	119
59					120	101
60					121	122
61					123	102
62					124	125
63					126	127
64					128	129
65					130	131
66					132	92
Ground (when used)	50 &	52			111 &	75
Vcc (when used)	49 &	51				

Note: RETURN is to be used as the complement of SIGNAL for a balanced pair, or as the ground reference for an unbalanced pair.

4.2.5c Digital Signal Classes and Standard Markings for Coaxial Connectors

References
TID-25875 EUR 4100e, 1972 Sections 4.2.5 7.2

For the information and guidance of users, each coaxial connector on the front or rear panel of a CAMAC plug-in unit should have a clear indication of its signal class.

Two signal classes are defined in TID-25875 (EUR 4100e):

Digital Signal Classes

CAMAC Unterminated. Receivers and drivers for a class of unterminated signals compatible with TTL or DTL integrated circuits are defined in 7.2.1 (Table VIII) of TID-25875 (EUR 4100e). (Note that the signal levels defined in Section D-6 of the NIM Specification TID-20893 may not be compatible with CAMAC unterminated signals because of logic level or current level differences).

CAMAC Terminated (NIM Fast). Receivers and drivers for a class of terminated signals compatible with the NIM Fast Logic Levels are defined in 7.2.2 (Table IX) of TID-25875 (EUR 4100e). Section 7.2.2 specifies that the signal is terminated in 50 ohms. The termination may be incorporated in the receiver. If this is the case, the input is referred to as being Internally Terminated. Alternatively, it may be desired to permit chaining of a commonly used signal to several plug-in units from a single driving circuit. In this case, the termination is external and the input is said to be Externally Terminated. The plug-in unit accepts the signal via a tap whose impedance is high compared to 50 ohms. The signal is terminated in 50 ohms at the end of the chain.

Standard Identifying Marks

The signal class associated with each coaxial connector mounted on a front or rear panel of a CAMAC plug-in unit should be clearly indicated. It is recommended that the indications be either a letter code or a color code as shown in the table below. For example, the color code could consist of a colored ring around the connector or a washer of permanently colored material mounted under the coaxial connector. The washer must not interfere with any intended grounding of the connector body to the panel.

Pairs of connectors for Externally Terminated signals should be mounted close together. The panel should have an engraved, painted or otherwise suitably affixed line between the connectors that form a pair.

Recommended Identifications for Coaxial Connectors

Signal Class	Letter Code	Color Code
CAMAC Unterminated	TTL	Light Blue
CAMAC Terminated (Internally Terminated)	50	Black
CAMAC Terminated (Externally Terminated)	HiZ	Gray

Inputs and outputs should be clearly differentiated.

K4.4a Dataway Wiring

References
TID-25875 EUR 4100e, 1972 Section 4.4 and Tables I, II and III

Figure K4.4a shows the Dataway wiring in a crate with 25 stations. The 24 normal stations (Station numbers 1-24) of the crate are wired identically. The wiring of the control station (Number 25) is different from that of the normal stations. Since a crate controller must have access to the Read (R) and Write (W) bus-lines, it must occupy at least one normal station in addition to the control station.

The Dataway lines (and contacts) fall into the four categories described below:

1. All Station Bus-Lines linking corresponding Dataway connector contacts at all stations, including the control station. There are 31 such bus-lines as follows:

Function Lines F	5	Busy B	1
Subaddress Lines A	4	Response Q	1
Inhibit I	1	Strobe S1, S2	2
Clear C	1	Command Accepted X	1
Initalize Z	1	Power Supply Lines	14

2. Normal Station Bus-Lines linking corresponding Dataway connector contacts at all normal stations, but not connected to the control station. There are 50 such bus-lines as follows:

Write Lines W	24
Read Lines R	24
Free Bus-Lines P1, P2	2

3. Individual Lines between the control station and each normal station. There are two such lines for each normal station, the N line (Station Number Line), by which the control station addresses specific normal stations, and the L line (Look-at-me Line), by which specific stations advise the control station that they desire attention. Thus 24 N lines and 24 L lines connect to the control station.

4. Patch Contacts for each Dataway Station that are not connected to the Dataway and are thus available for patch connections. There are 3 patch contacts for each normal station and 7 for the control station.

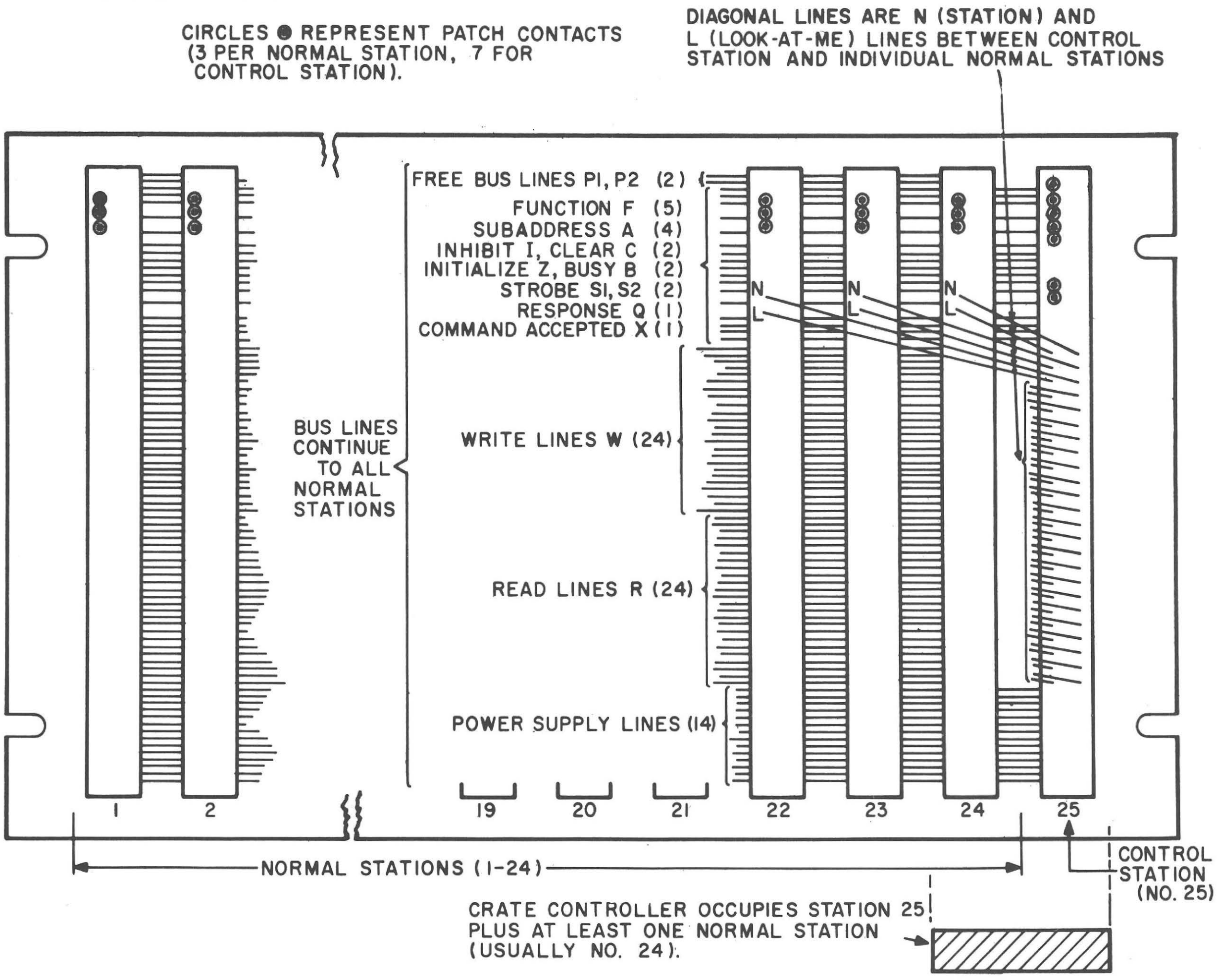


Fig. K4.4.4a. Dataway Wiring, Front View of 25-Station Crate

.4b Dataway Patch Contact Terminals

References
TID-25875 EUR 4100e, 1972 Sections 4.4 5.6.2

It is mandatory that patch contacts (such as wire-wrap terminals) be provided for P3-P5 of normal stations and P1-P7 of the control station. In addition, it is preferred practice to have such contact terminals provided also for I, C, and the 0 volt (Power Return) busses and for each N and L line.

.4c Dataway Artwork

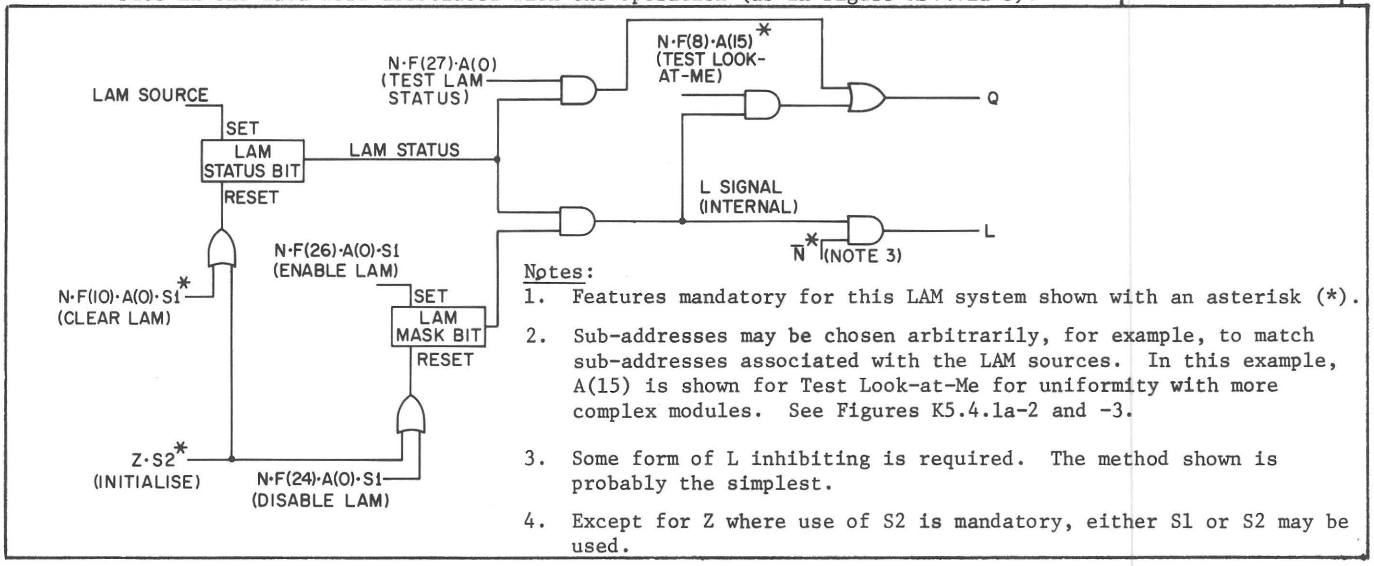
References
TID-25875 EUR 4100e, 1972 Section 4.4

Artwork for multilayer printed Dataway boards has been prepared by various laboratories. Photographic prints of a Lawrence Berkeley Laboratory example are available. (See note in K4.1.1a)

References
TID-25875 EUR 4100e, 1972 Section 5.4.1 Figure 11

K5.4.1a Examples of LAM Logic

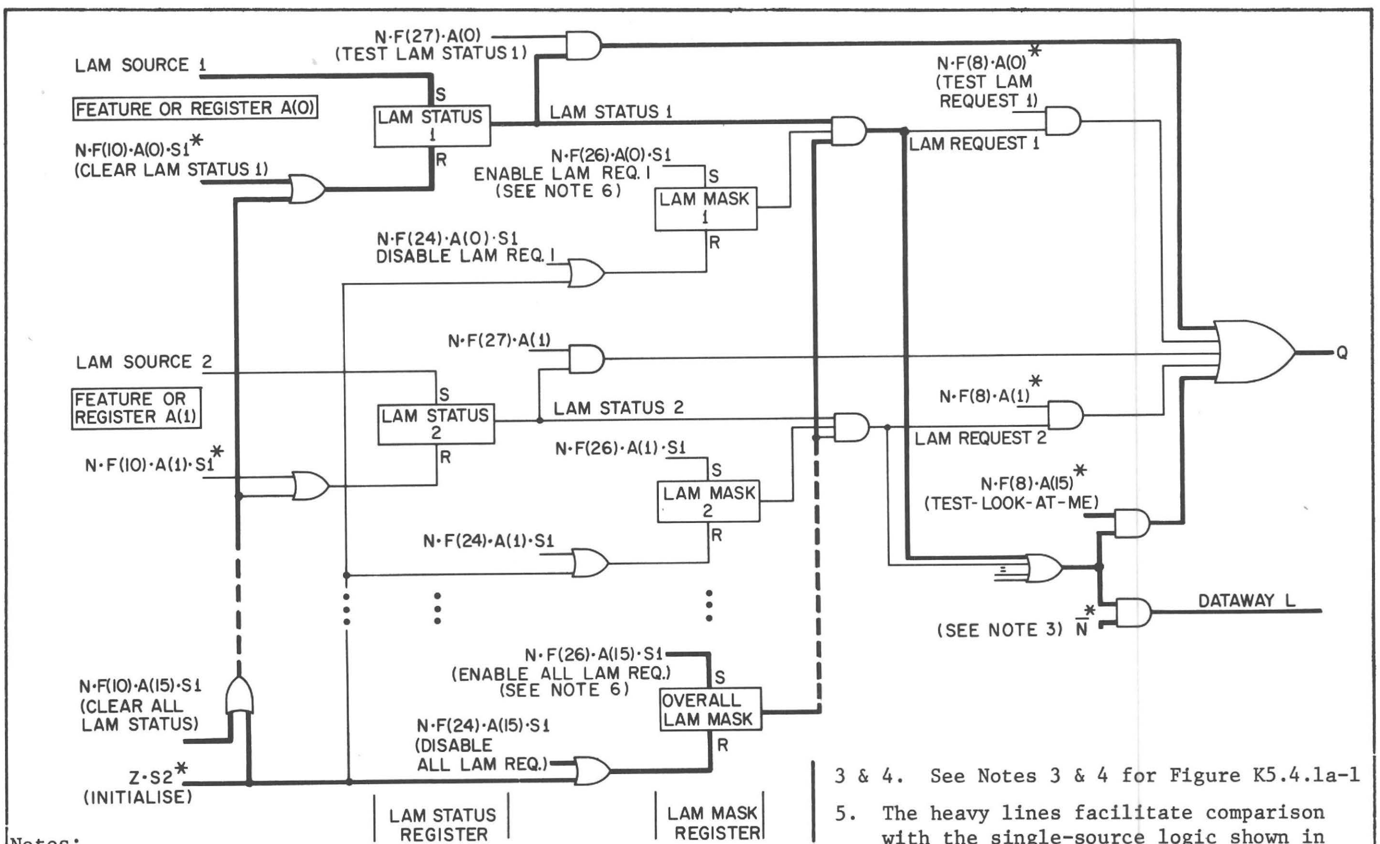
Figures K5.4.1a-1, -2 and -3 are examples of LAM Logic in modules. Figure K5.4.1a-1 shows an example of LAM logic for a module with a single source of Look-at-Me. For modules having multiple sources of Look-at-Me, operations on the LAMs may be addressed via sub-addresses (as in Figure K5.4.1a-2) or via bits in the data word associated with the operation (as in Figure K5.4.1a-3).



Notes:

1. Features mandatory for this LAM system shown with an asterisk (*).
2. Sub-addresses may be chosen arbitrarily, for example, to match sub-addresses associated with the LAM sources. In this example, A(15) is shown for Test Look-at-Me for uniformity with more complex modules. See Figures K5.4.1a-2 and -3.
3. Some form of L inhibiting is required. The method shown is probably the simplest.
4. Except for Z where use of S2 is mandatory, either S1 or S2 may be used.

Fig. K5.4.1a-1. Example of Single-Source LOOK-AT-ME Logic



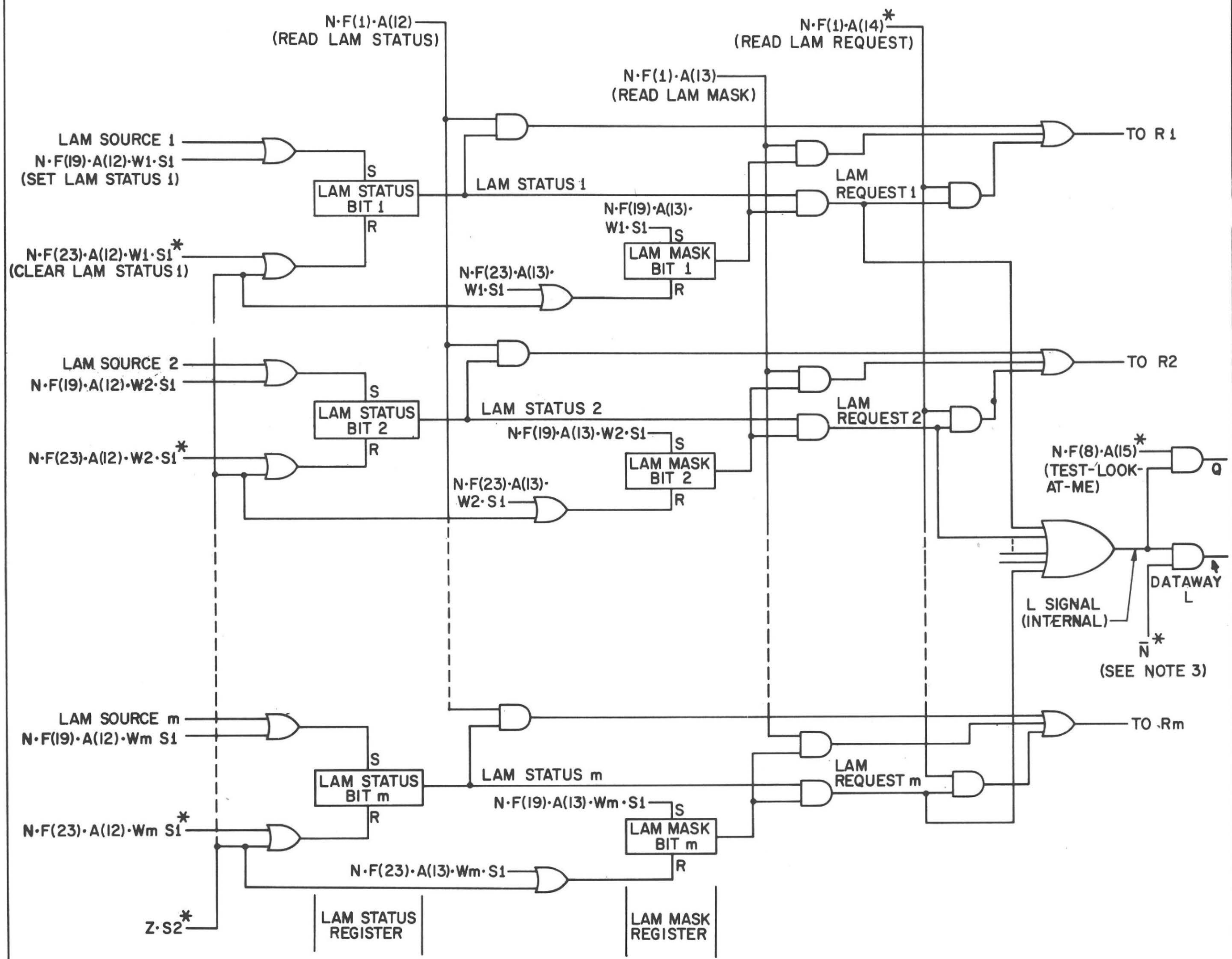
Notes:

1. Mandatory features for a module which performs operations on LAMs via sub-addresses are shown with an asterisk (*).
2. Although choice of sub-address is arbitrary, it is generally useful to use the same sub-address for the commands associated with a given LAM source. For example, the figure shows sub-address A(0) used for LAM source 1; A(1) for LAM source 2, etc. Sub-addresses A(15) is suggested for operations which affect all LAM sources, e.g., Enable/Disable all LAM requests and Test L signal.

3 & 4. See Notes 3 & 4 for Figure K5.4.1a-1

5. The heavy lines facilitate comparison with the single-source logic shown in Figure K5.4.1a-1.
6. For modules that include both individual LAM masks and an overall LAM mask (as above), the module information summaries must point out that an individual LAM Request is enabled only if its **individual** mask and the overall mask have **both been** set.

Fig. K5.4.1a-2. Example of Multiple-Source LOOK-AT-Me Logic Showing Operations on LAMs via Sub-Addresses



Notes:

1. Features which are mandatory for a module which performs operations on LAMs via Databits are shown with an asterisk (*).
2. Although A15 is shown, choice of sub-address for Test Look-at-Me is arbitrary. All other sub-addresses shown are those recommended in 5.4.1.2
3. See Note 3 for Figure K5.4.1a-1.
4. See Note 4 for Figure K5.4.1a-1.
5. Appropriate logic should be provided to ensure that LAM status bits cannot be set during Dataway command cycles for Read LAM Status and Read LAM Request.

Fig. K5.4.1a-3 Example of Multiple-Source LOOK-AT-ME Logic Showing Operations on LAMs via Databits

K5.4.4a Command Accepted (X and BX) Disabling

See L4.2.3

References
TID-25875 EUR 4100e, 1972 Section 5.4.4

K5.4.4b Interpretation of Command Accepted (X) Response for Q-Controlled Block Transfers

References
TID-25875 EUR 4100e, 1972 Sections 5.4.3 5.4.4

1. Address Scan (5.4.3.1) During the operation by a controller of an Address Scan algorithm, there are two conditions where X=0 does not indicate a malfunction. In both these conditions, Q=0 responses are also generated. This means that, during an Address Scan, controllers should interpret X=0 as an indication of serious malfunction (See L4.2.3) only if Q=1. The two conditions are described below:

K5.4.4b cont. As stated in 5.4.3.1, the addressing of each register in a sequence intended to be used in the Address Scan mode of block transfer must result in a response of Q=1. The addressing of the first register location (if any) beyond the sequence must result in a Q=0 response. This is the mechanism used to locate the end of the sequence. If the first location beyond the sequence is vacant, addressing it also results in an X=0 response. However, if this register location is used for a non-Address Scan register, then, as it is addressed, an X=1 response is proper, even though the Q response must be 0. (Q=1, X=0 is always a fault condition).

The operation of an algorithm used by the controller during Address Scan may result in addressing an empty station. The response to such a command is always X=0.

2. Repeat (5.4.3.2) During Repeat mode, the state of the Q response conveys information on the readiness of the addressed register to participate in a data transfer. (Q=1 means ready; Q=0 means not ready). Regardless of the logic state of the Q response, the Command Accepted response should be X=1.

3. Stop (5.4.3.3) During Stop mode the state of the Q response conveys information as to whether the transfer of the current data word to or from the addressed register is within or without a data block. (Q=1 means within; Q=0 means without.) Regardless of the logic state of the Q response, the Command Accepted response should be X=1.

K5.7a Reserved Power Lines Y1 and Y2

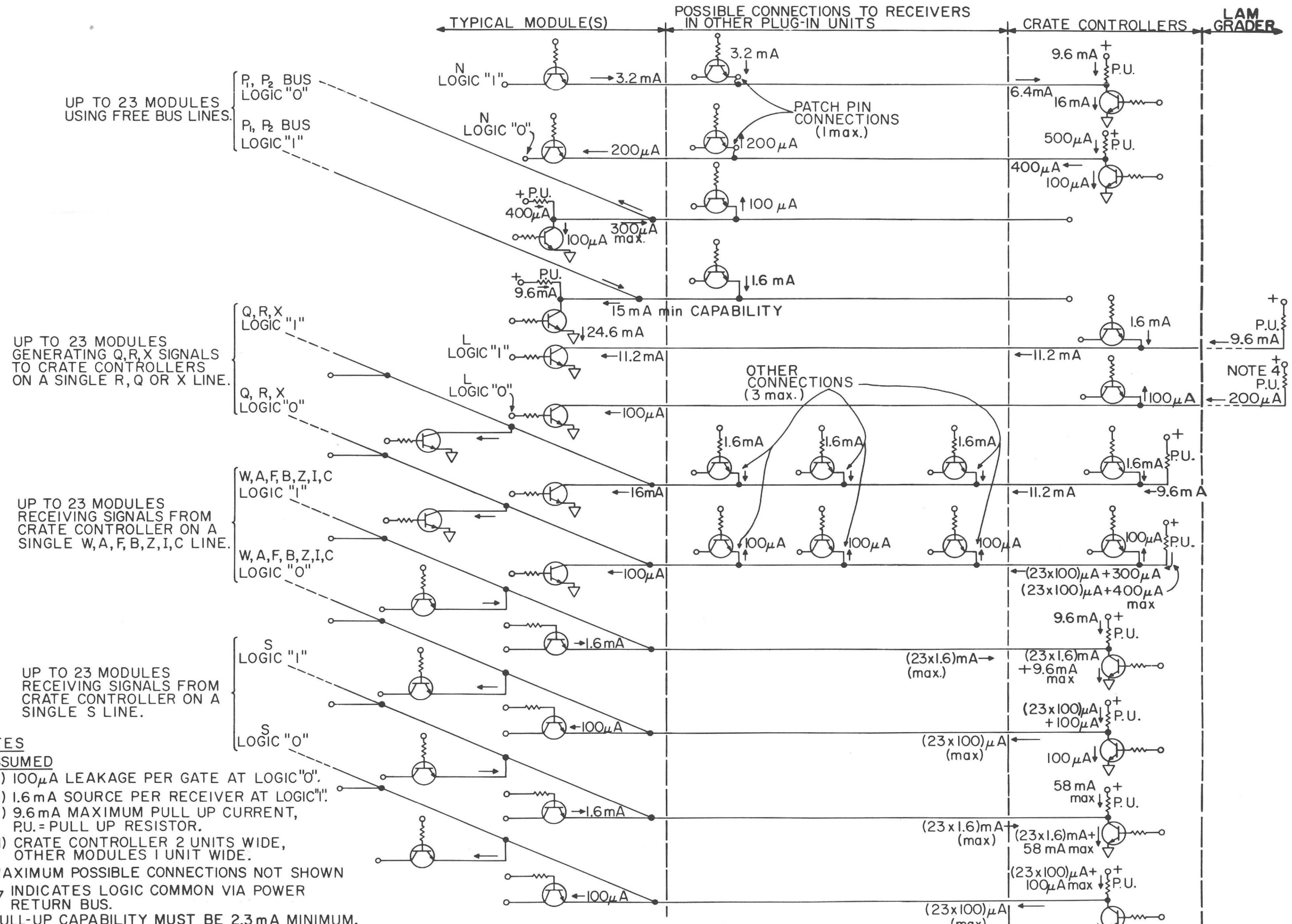
See K8c

References
TID-25875 EUR 4100e, 1972 Sections 5.7 & 8 Tables I, II, III

K7.1.2a Current Distribution, CAMAC Dataway

Table VI of TID-25875 (EUR 4100e) gives the standard for signal currents through Dataway connectors, and for pull-up current sources, while Table VII gives the current standards for patch contacts. Figure K7.1.2a is included here to present these current standards pictorially, though the maximum possible connections are not shown.

References
TID-25875 EUR 4100e, 1972 Section 7.1.2 and Table VI



NOTES

1. ASSUMED
   - (a) 100μA LEAKAGE PER GATE AT LOGIC "0".
   - (b) 1.6 mA SOURCE PER RECEIVER AT LOGIC "1".
   - (c) 9.6 mA MAXIMUM PULL UP CURRENT, P.U. = PULL UP RESISTOR.
   - (d) CRATE CONTROLLER 2 UNITS WIDE, OTHER MODULES 1 UNIT WIDE.
2. MAXIMUM POSSIBLE CONNECTIONS NOT SHOWN
3. ▽ INDICATES LOGIC COMMON VIA POWER RETURN BUS.
4. PULL-UP CAPABILITY MUST BE 2.3 mA MINIMUM.
5. P_1 & P_2 MAY ALSO USE W/R CURRENT DISTRIBUTIONS.

Fig. K7. 1. 2a. Current Distribution, CAMAC Dataway

K8a Preferred Power Supply Connector

References
TID-25875 EUR 4100e, 1972 Section 8

A preferred power supply connector is designated for connecting power supplies to the Dataway power lines. The connector is listed in Table K8a together with contact assignments.

Table K8a. Preferred Power Supply Connectors and Contact Assignments

Original Manufacturer	AMP
Connector Type	AMP-INCERT Series M
Number of Contacts	50
Catalog Numbers Fixed Member (Crate connector) Free Member (Power supply connector)	 201358-3 200277-4

Suitable Contacts

AWG Wire Gauge	Type II (Machined)*** Pin*	Type II (Machined)*** Socket**	Type III+ (Formed)*** Pin*	Type III+ (Formed)*** Socket**
one #16 or #18	202507	202508	66098	66100
one #30	201555		66425	
two #18	202725		66359	

*Pins to be used in Fixed Member (Crate connector)
**Sockets to be used in Free Member (Power supply connector)
***Type II Contacts have lower resistance than Type III+ but are more expensive

CONTACT ASSIGNMENTS

A	117V AC Live	d	-12RS
B	117V AC Neutral	e	-6S
C	+200	f	-6RS
D	+200R	h	-6
E	Reserved	j	-6R
F	Reserved	k	-6
H	Reserved	m	-6R
J	Chassis Gnd, Status and Temp. Warn. Returns	n	-6
		p	-6R
K	Status	r	+6RS
L	Temp. Warn.	s	+6S
M	Y2R	t	+6R
N	Y2RS	u	+6
P	Y2	v	+6R
R	Y2S	w	+6
S	Y1S	x	+6R
T	Y1	y	+6
U	Y1RS	z	+12RS
V	Y1R	AA	+12R
W	-24	BB	+12S
X	-24S	CC	+12
Y	-24R	DD	+24RS
Z	-24RS	EE	+24R
a	-12	FF	+24S
b	-12S	HH	+24
c	-12R		

R indicates Return
S indicates Sense
RS indicates Return Sense

K8b Power Line Standards

The use of +12V, -12V and +200V dc and 117V ac in plug-in units should be avoided since these are nonmandatory voltages and will usually not be available on the crate power busses.

References
TID-25875 EUR 4100e, 1972 Section 8 and Table X

K8c Reserved Power Lines Y1 and Y2

The requirement of the Reserved Power Lines (Y1, Y2) is met provided that the Dataway construction is such that appropriate lines can be installed if and when these lines are fully defined.

References
TID-25875 EUR 4100e, 1972 Sections 5.7 & 8 Tables I, II, III

K8d Typical Power Supply

Appendix E is a description of a typical power supply for use with CAMAC crates.

References
TID-25875 EUR 4100e, 1972 Section 8 and Table X

K8e Marking of Voltage & Current Requirements on Plug-in Units

The voltage and current requirements should be clearly and permanently marked on all plug-in units, preferably on the front panels.

References
TID-25875 EUR 4100e, 1972 Section 8 and Table X

La Reference to EUR 4600e

The abstract and Sections A, B, and F of TID-25876 incorrectly refer to "EUR 4600e dated October 1971." They should refer to EUR 4600e dated 1972.

References
TID-25876 Abstract and Sections A,B,F

L1a CAMAC Compatibility

See K1a and Appendices F and G.

References
TID-25876 EUR 4600e, 1972 Section 1 TID-25875 EUR 4100e, 1972 Section 1

L3a Branch Highway Length Limitations

Standard Highway

The standard branch highway, described in TID-25876 (EUR 4600e), uses a single-ended (unbalanced) mode of signal transmission.

References
TID-25876 EUR 4600e, 1972 Section 3

This mode gives reliable transmission in systems where the total length of the highway is not excessive. A reasonable figure for maximum length is about 25 meters for cables using #26 AWG conductors, although longer branch highways of this type have been used successfully.

However, as the highway length is increased, the dc voltage drops due to signal currents flowing in the conductors begin to seriously reduce the signal voltages at the receivers. This reduction in signal voltage results in a reduction of noise margin .

Figure L3a-1 shows curves of logic '1' receiver input voltage as a function of branch highway length for different wire sizes when terminated as recommended in Table VIII of TID-25876 (EUR 4600e). These curves are based on a driver circuit that produces the maximum permitted logic '1' level of 0.5 volts. The maximum specified logic '1' level at the receivers is 1.2V. Thus, the guaranteed noise margin at zero highway length is 0.7V. The 0.85V line represents the receiver voltage at which the guaranteed noise margin is (1/2)(0.7)=0.35V. The branch highway lengths corresponding to this noise margin are 16, 25, 40 and 66 meters for 28, 26, 24 and 22 AWG wire sizes, respectively; larger conductors will permit correspondingly longer branch highways though the diameter of the cable may be too great for direct entry into the hood of the branch highway connector.

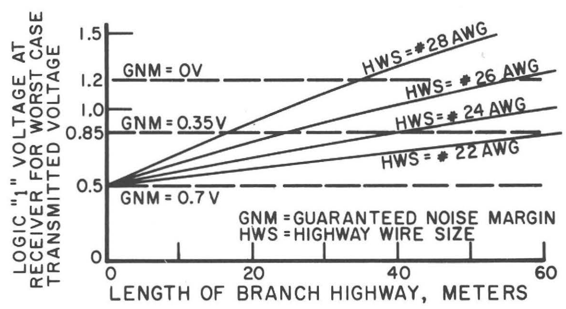


Fig. L3a-1. Branch Highway Receiver Input Voltage

Balanced Highway

A branch can be conveniently extended beyond the limits discussed above by the use of single-ended-to-balanced converters. In this scheme, signals are transmitted over a long span of distance using a balanced transmission mode. At each end of the span the balanced signals are converted to the standard branch highway mode, with appropriate termination of the single-ended signals. Aside from the converters and the balanced span, other components (for example, all branch drivers and crate controllers) are completely CAMAC standard. Figure L3a-2 shows the configuration of such a system. It has two long distance links each of which utilizes the balanced signal transmission mode. A indicates Crate Controller Type A. SE/Bal ↓ , Bal/SE ↑ indicates single-ended-to-balanced, balanced-to-single-ended converter. Transient protection may be necessary on long lines.

Figure L3a-3 shows curves of received signal voltage as a function of transmission line length for a differential (balanced) signal transmission system using current-switching transmitters. The curves are based on IR drops in a cable using #22 AWG conductors.

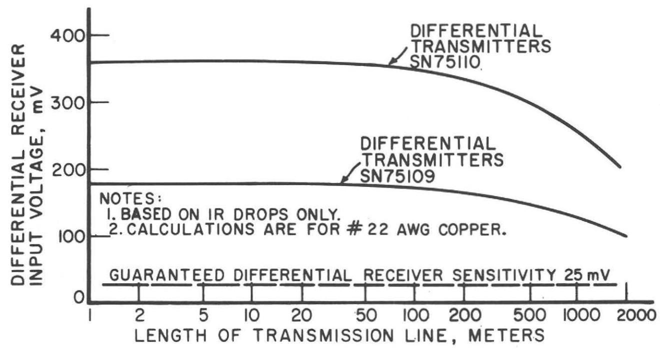


Fig. L3a-3. Differential Receiver Input Voltages

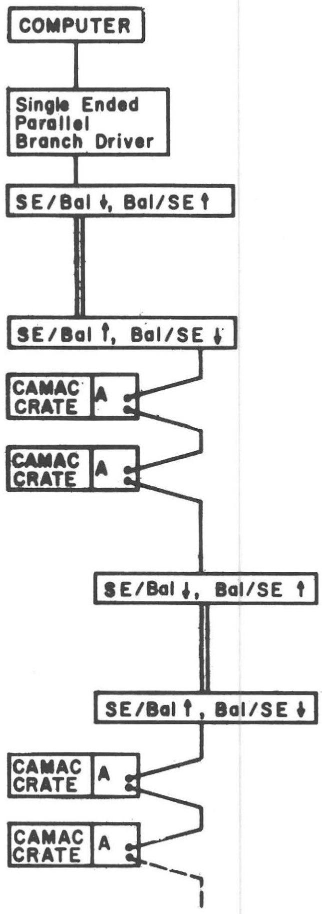


Fig. L3a-2.

Balanced Transmission System With Single-Ended-To-Balanced Converters

14.2.3 Command Accepted (X and BX) Disabling

CAMAC computer interfaces, whether crate controllers or branch drivers, that include provisions for monitoring the Command Accepted (X or BX) response should also include a mode of operation in which an X (or BX) = 0 response does not result in an automatic system alarm. This mode is necessary to permit "normal" operation of a system that includes early plug-in units that do not have provision for generating or transmitting the Command Accepted signals. Such plug-in units always "respond" with X=0. When performing an Address Scan block transfer the combination Q=0, X=0 should not result in an automatic system alarm.

References
TID-25876 EUR 4600e, 1972 Sections 4.2.4 A1.4 and Figure 7 TID-25875 EUR 4100e, 1972 Section 5.4.4

Appendix A

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Appendix B

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Appendix C

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Appendix D

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Appendix E

Description of a Typical CAMAC Power Supply

Type CP-1

A. General

The power supply described herein is suitable for use with the CAMAC Module Instrumentation System for Data Handling.

This description is written in the form of a specification for the convenience of those who wish to use it for that purpose.

Due to the high operational reliability required, only the highest quality components should be employed. All semiconductor components shall be silicon, and shall be encapsulated in metal or ceramic, hermetically sealed, cases. Components shall not be used beyond their design ratings. The supply shall be designed with a life expectancy of at least 5 years. See Fig. E1 for block diagram. Wiring to the right of PG-26 is not considered part of the power supply.

B. Input

The input voltage shall be the nominal line voltage, +10% to -12%, at nominal line frequency ±3 Hz. In the U.S. the nominal line voltage is 117V and the nominal line frequency is 60 Hz.

C. Output

The supply is to provide four d.c. outputs with at least the following current ratings:

Voltage Volts	Current Amperes
+ 6.00	0 to 25
- 6.00	0 to 25
+ 24.00	0 to 6
- 24.00	0 to 6

The four outputs shall be simultaneously available but the currents may be limited to a minimum total output power of 294 watts. The ±6.0V supplies shall operate on a current sharing basis, such that the total combined current outputs may be limited to 25A. Likewise, the ±24V supplies shall be current shared, and may be limited to a total combined current output of 6A. Rated output current shall also be available to loads connected between the positive outputs and the negative outputs.

If the output power demanded should exceed a safe operating value, the supply shall protect itself.

Remote sensing shall be utilized on all outputs of this power supply. Remote sense points can be expected to be within 305 mm of the crate connector, PG-27. All wiring shall be in accordance with Fig. E1.

D. Regulation and Stability

1. During a 24-hour period the ±6.0V outputs shall vary by not more than ±0.5% due to changes of input voltage and output current within the specified ranges.

2. During a 24-hour period the ±24V outputs shall vary by not more than ±0.2% due to changes of input voltage and output current within the specified ranges.

3. The long-term stability shall be such that, after a 24-hour warmup, over a 6-month period for constant load, line, and ambient temperature conditions, the ±6.0V output shall drift not more than ±0.5%; the ±24V outputs shall drift not more than ±0.3%.

E. Noise and Ripple

Noise and ripple, as measured on an oscilloscope of d.c. to 50 MHz band-width, shall not exceed 15 mV peak-to-peak.

F. Temperature and Temperature Coefficient

The ambient temperature range is from 0°C to 50°C without derating. Ambient temperature as used throughout this specification shall be taken at a location that is not affected by the temperature of the power supply.

The output voltage coefficents for changes in ambient temperatures between 0°C and 50°C shall not exceed 0.02%/°C.

G. Voltage Adjustment

The output voltage shall be adjustable over a nominal range of at least ±2% by means of screwdriver adjustments accessible through the rear or top of the supply. The maximum error in resetting each output voltage shall be ±0.5%.

H. Recovery Time and Turn-on - Turn-off Transients

The outputs shall recover to within ±0.2% of their steady state values within 1 ms for any change within the specified input voltage and for a 50% rated load current change. The peak output excursions during 1 ms shall not exceed ±5% of rated voltage for such line or load changes, and shall be proportionately less for smaller changes.

Response to input voltage changes or to ±5% busline voltage changes shall be non-oscillatory.

From turn-on the power supply output shall stabilize to within ±1% of its final value within one minute for constant line, load, and ambient temperature. The turn-on and turn-off transients shall not exceed 20% of the nominal voltage.

I. Magnetic Field Effects

A magnetic field of 50 gauss in any direction shall not cause performance characteristic variations of more than ±0.5%.

J. Power Transformers

The power transformers shall be constructed with an electrostatic shield which is connected to the core.

K. Terminals

All wiring shall be as shown in Fig. E1.

(1) When designed for use with 117V a.c. mains, a three-wire power cord of approximately 1.5 meters in length shall be included. It shall have a NEMA CAP, 5-15P. The power cord may be permanently attached to the power supply, or alternatively, may terminate in a NEMA CONNECTOR BODY 5-15R, mating with a NEMA INLET 5-15P on the Power Supply.

(2) The d.c. output power shall be supplied via a connector (PG26) as designated in Fig. E1, or mating equivalent. Wire size, socket types, and pin assignments are specified in Fig. E1.

L. Protection

(1) The input of the supply shall be protected with a fuse of adequate rating in each side of the line. The fuses shall be readily accessible.

(2) The output of the supply shall be short-circuit protected by means of an electronic circuit. The current limiting threshold shall be set at least 0.2 ampere above the specified maximum output currents. The output voltage shall be resumed after the short has been removed. A continuous short circuit shall not damage the supply or blow a fuse.

(3) The output shall be protected by limiting circuits so that under no conditions will the $\pm$24V outputs exceed 34V or the $\pm$6.0V outputs exceed 7.5V. Operation of the over-voltage protection shall not damage the power supply.

(4) In no case shall a failure of any supply cause an increase in voltage of any other supply by more than 20%.

(5) The power supply shall not damage itself and the conditions of L(3) shall apply if the power supply is turned on with any or all pins of PG-26 disconnected.

(6) Thermal protection circuits shall be provided to disable the supply when the temperature exceeds a safe operating value.

The maximum safe operating temperature, as measured at the thermal switch, shall be specified on the schematic circuit diagram.

M. Crate Ventilation

This power supply shall include fans and mechanical assembly to provide forced air ventilation of a CAMAC crate. Air flow of at least 12 CFM shall be directed into each of four equal crate sections extending from front-to-back. The air flow impedance of densely packed CAMAC modules in all twenty-five stations shall be considered in determining the minimum air flow rate.

Air shall be drawn from directly in front of the rack in which the assembly is mounted. Air filters allowing a visual inspection from the front, shall be included. The air shall be channelled in such a way that it does not experience an appreciable temperature rise due to the heat of the power supply. The unit shall include a POWER ON-OFF switch which simultaneously provides power to both the fans and to the power supply.

N. Mounting

The supply shall be constructed for rack mounting immediately below a CAMAC crate in such a fashion that the ventilation requirements of this specification are achieved.

(1) Fig. E2 specifies several outline dimensions and component locations to which the unit must adhere.

(2) Interface housing units (see Fig. E5) mechanically adapt CAMAC crates from various sources to this power supply. They also house and protect PG-27, power bussing, and the dataway connectors.

An interface housing unit is not a part of this specification. The power supply shall, however, be provided with four #10-32 captive screws in the positions shown in Fig. E2 as a means of securing to an interface housing unit.

(3) The panel height of the supply is not specified Panel height is at a premium in rack space. Trade offs between panel height and power supply costs should be optimized.

O. Monitoring

(1) Front panel metering shall be provided to monitor the four d.c. voltages and their current loads. The metering shall be accurate to $\pm$2.5% full scale.

The meter scales shall be calibrated with full scales of 8 and 30, and shall have labeled markers at nominal voltage values and at rated current values.

(2) A front panel neon lamp (or suitable solid state indicator) wired as shown in Fig. E1 shall be provided to indicate the a.c. power on condition.

(3) A front panel thermal warning light, wired as shown in Fig. E1 shall be provided. It shall light whenever the temperature within the supply exceeds a value 20°C below the maximum safe operating temperature.

P. Mechanical Construction

(1) Insulating materials such as printed wiring boards shall be flame retardant.

(2) All components shall be accessible for testing and replacement.

(3) All integrated circuits shall be mounted in high quality I.C. sockets.

(4) Markings: Major components such as solid state devices, transformers (including leads) large capacitors, controls, and terminals shall be marked in the most readable position in the unit with respect to their identification on the schematic diagram.

Q. Circuit Diagram

Two copies of the schematic circuit diagram, which include component values, shall be provided with each supply. All semiconductor components shall be designated by EIA numbers or in nomeclature commonly used by semiconductor manufacturers or shall be directly replaceable by the same. Where special types are used, the schematic diagram or instruction book shall recommend a semiconductor manufacturer's equivalent that will provide satisfactory performance.

R. Finish

All front panel metal surfaces shall be finished with a baked-on enamel or with an equally hard, chip-resistant, material. All surfaces not seen from the front may be finished similarly, or may be finished with cadmium plate, nickel plate, or iridite.

Numerals 1 through 25, representing station numbers in a CAMAC crate, and to identify modules inserted into a crate which may be mounted immediately above the supply, shall be printed on the front panel near the top edge. They shall be in consecutive order from left to right as viewed from the front with the numeral 13 at the front panel centerline, and shall be positioned at 17.2mm intervals. The numerals shall be at least 4mm in height.

S. Test Conditions

305 mm of lead shall be used to simulate crate wiring between PG27 and the dataway power bus. Sense leads and test-load leads shall be attached at this distance from PG27, and measurements to determine adherence to these specifications shall be made at this point. Users are alerted to the fact that, in practice, performance will depend upon the actual positions of sense points and the reactive nature of loads.

T. Optional Feature - STATUS BIT

A STATUS BIT to indicate whether the power unit is functioning normally may be provided. This optional feature, when provided, shall be standardized as follows:

(1) The STATUS BIT source shall be a relay which provides contact closure when in the alarm condition; shorting the STATUS BIT line to the power-unit chassis. Under normal operating conditions, the STATUS BIT line shall be an "open circuit" in the power unit.

Contact rating shall be minimally 50V, 500 ma.

(2) The STATUS BIT alarm condition shall indicate that any one of the following conditions exist:

a. Any one of the voltages supplied by the unit is outside of specified voltage range.

b. Any one or combination of supplies is being loaded beyond specified current range.

c. The thermal warning switch is in the alarm condition.

The STATUS BIT may indicate additional alarm conditions at the option of the manufacturer, but a., b. and c. must minimally be included.

(3) In the power unit, the STATUS BIT shall be wired to contact K of PG26 and to a front panel 50CM coaxial connector.

FIGURES

NOTE:

The information on Figures E5 and E6 indicate preferred practice for fabrication and assembly of CAMAC crate wiring and the interface housing unit. It is presented in this DESCRIPTION OF A TYPICAL CAMAC POWER SUPPLY because of the intimate relationship between these items and the power supply and ventilation unit.

NOTES:–

1. OPTIONAL VOLTAGES. PINS RESERVED FOR OPTIONAL VOLTAGES NOT SUPPLIED BY THIS UNIT. IF WIRED, MINIMUM WIRE GAUGES SHOWN PERTAIN.
2. ALL PINS WIRED AS SHOWN. PG27 AND CAMAC CRATE WIRING ARE NOT PROVIDED WITH THIS POWER SUPPLY.
3. SUFFICIENT LENGTH, POSITIONING, AND FLEXIBILITY TO MATE WITH CRATE CONNECTOR MOUNTED AS SHOWN IN FIG. E2 (MINIMUM LENGTH, 305 mm).
4. PG26 AMP BLOCK 200277-4, WITH SIZE 16 SOCKET CONTACTS:
   PG27 AMP BLOCK 201358-3, WITH SIZE 16 PIN CONTACTS:

AWG WIRE GAUGE	USEABLE AMP CONTACTS TYPE II PIN	TYPE II SOCKET	TYPE III+ PIN	TYPE III+ SOCKET
ONE #16 OR #18	202507	202508	66098	66100
ONE #30	201555	-------	66425	------
TWO # 18	202725	------	66359	-----

   OTHER CONNECTORS FULLY MATEABLE WITH THESE AND WITH AT LEAST 13 AMPERES PER CONTACT RATING MAY BE USED.
5. 24 INDICATES 24 VOLT LINE
   24 R " 24 VOLT RETURN LINE
   24 S " 24 VOLT SENSE LINE
   24 RS " 24 VOLT RETURN SENSE LINE
   Etc FOR OTHER VOLTAGES
6. PG1 OPTIONAL
7. OPTIONAL FEATURE, SECTION T.
8. POLARIZATION OF CONNECTORS PG26 AND PG27 IS TO BE PROVIDED BY THE USE OF TWO GUIDE PINS IN THE CORNER HOLES OF ONE END AND TWO GUIDE SOCKETS IN THE CORNER HOLES OF THE OTHER END OF EACH CONNECTOR BLOCK, AS SHOWN BELOW:

BLOCK	AMP GUIDE PIN AND GUIDE SOCKET PART NUMBERS PG26	PG27
BLOCK END A, B	200833 (GP)	200835 (GS)
BLOCK END FF, HH	200835 (GS)	200833 (GP)

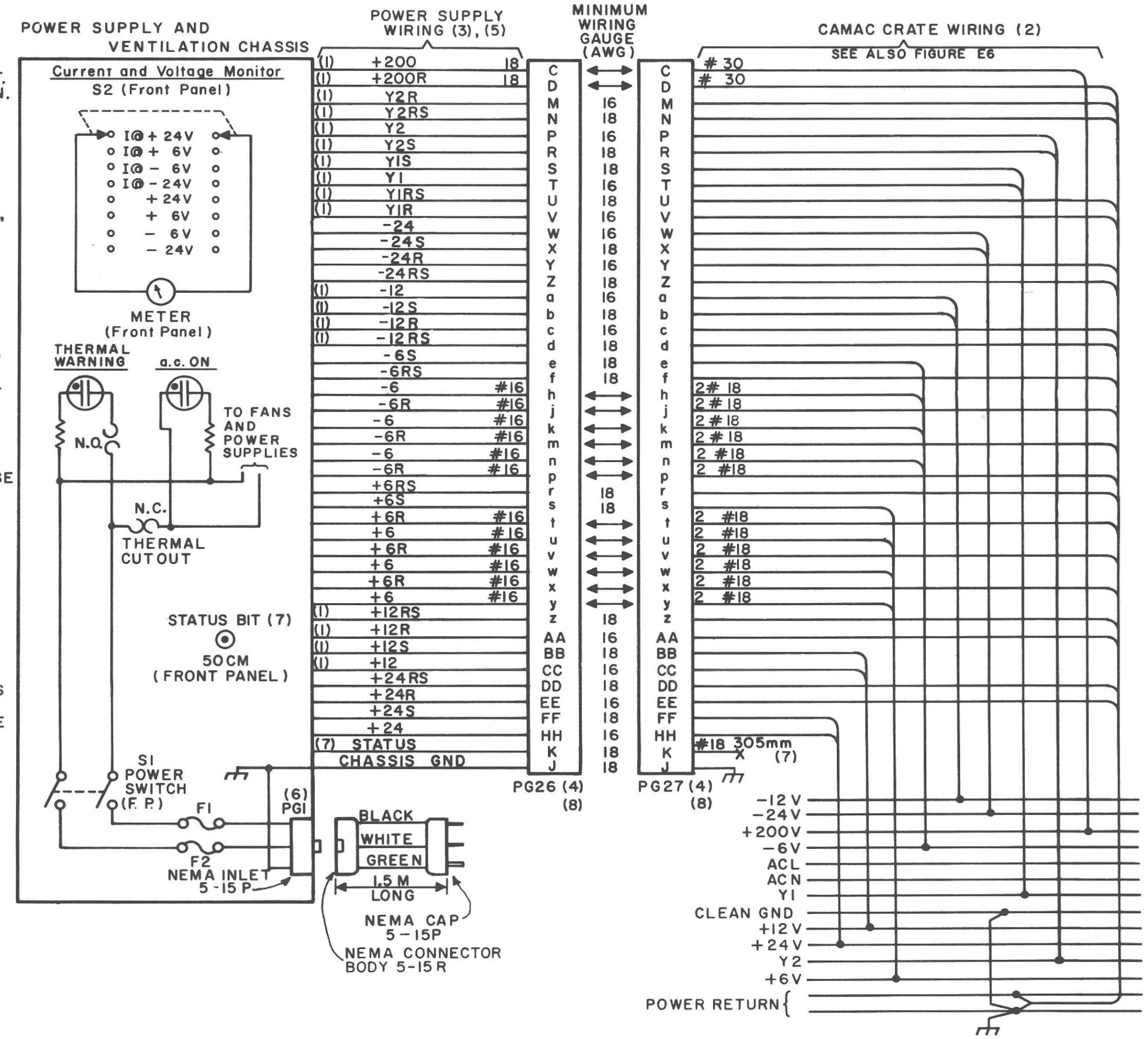


Fig. E1. Interconnection Block Diagram

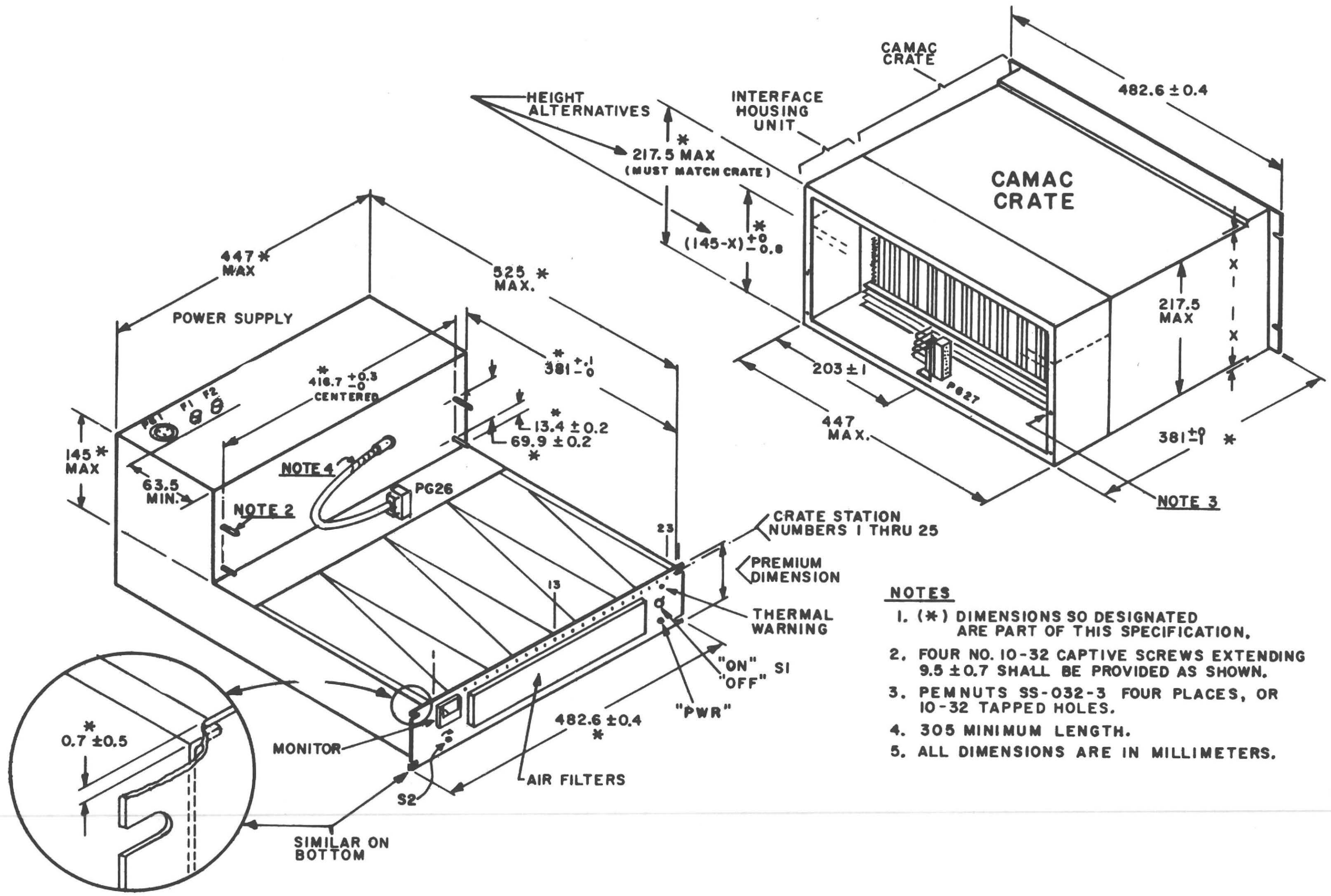


Fig. E2. Maximum Outline Dimensions and Illustrative Unit

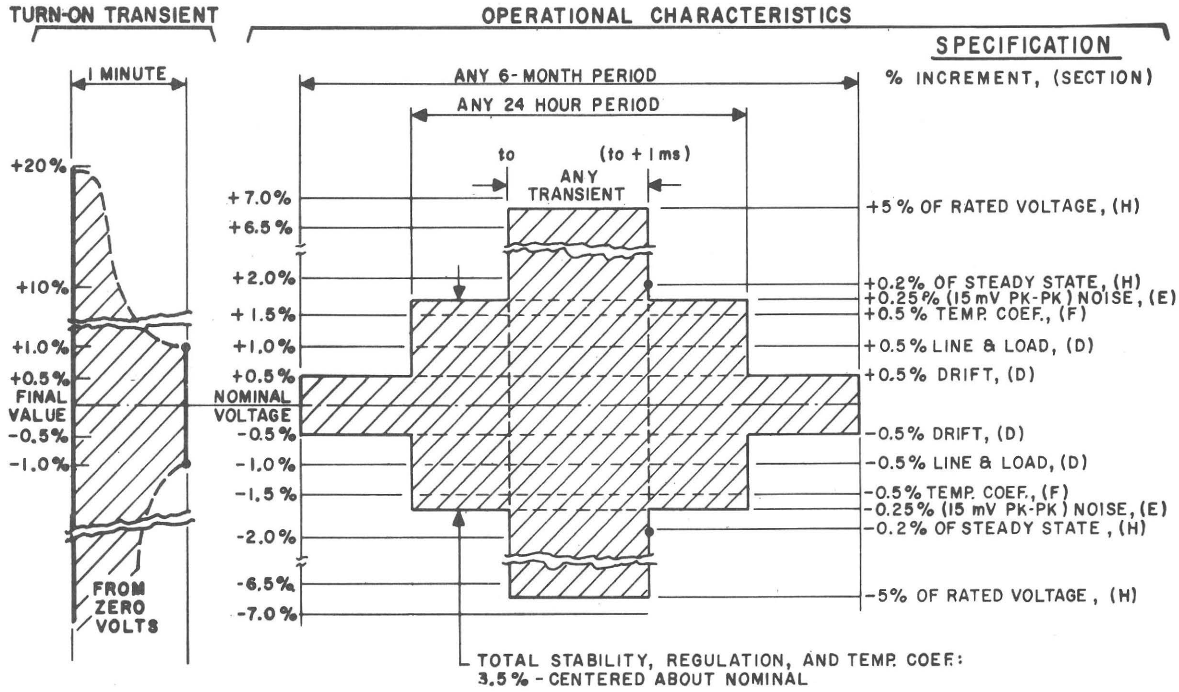


Fig. E3. ±6V, Time and Voltage Characteristics

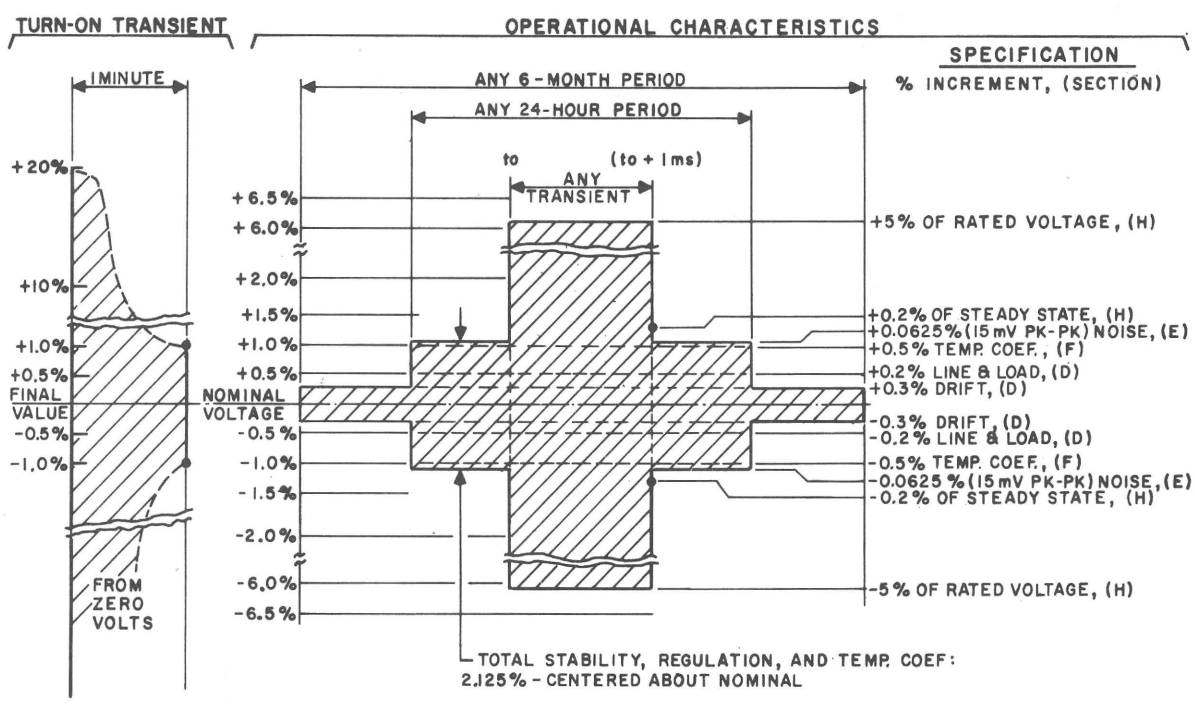
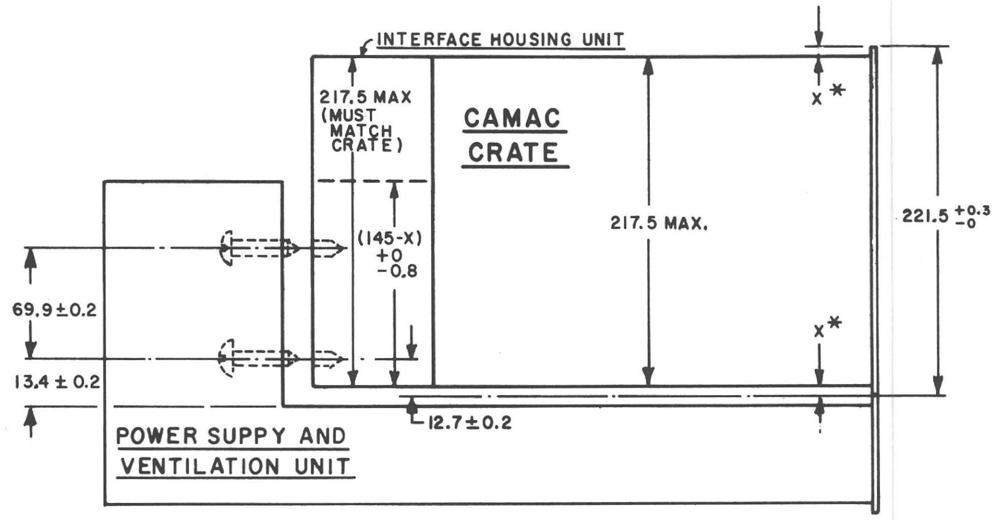
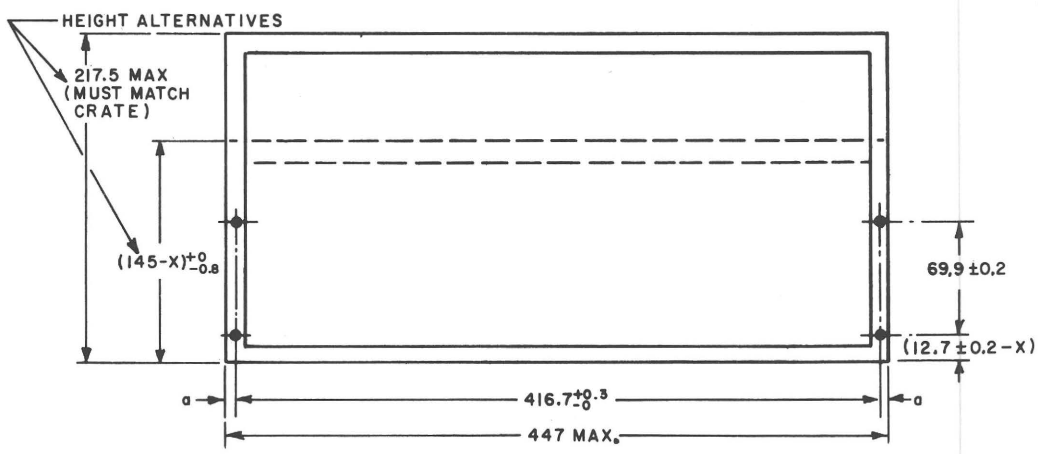


Fig. E4. ±24V, Time and Voltage Characteristics



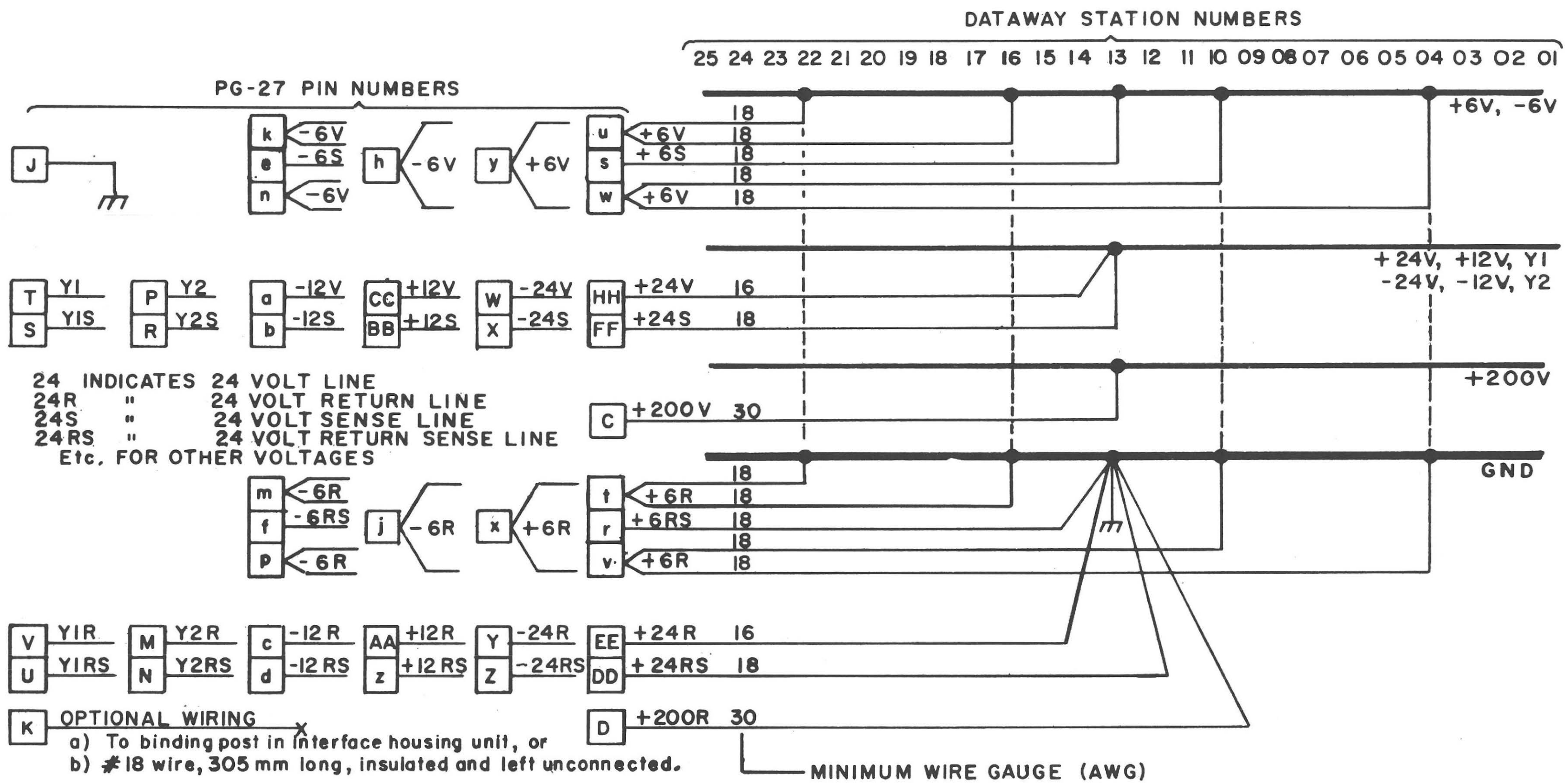
ASSEMBLY - SIDE VIEW



INTERFACE HOUSING UNIT– REAR VIEW

* X DIMENSION VARIES WITH CRATES FROM DIFFERENT MANUFACTURERS.
SKETCHES NOT TO SCALE.

Fig. E5. Interface Housing Unit, #10 - 32 Tapped Hole Locations



PG27 AMP BLOCK 201358-3 OR EQUIVALENT.
PIN FOR SINGLE #16 OR #18 WIRE - AMP III+ (66098) OR AMP II (202507) OR EQIVALENT.
PIN FOR TWO # 18 WIRES - AMP III+ (66359) OR AMP II (202725) OR EQUIVALENT.
PIN FOR # 30 WIRE - AMP III+ (66425) OR AMP II (201555) OR EQUIVALENT.

Fig. E6. Power Busses and Power Return Bus, Feed and Sense Wiring

Appendix F

An Examination of the 1972 Revision of the CAMAC Specifications and Resulting Compatibility Aspects

1.0 Introduction

The CAMAC 1972 specifications include a number of changes from the original version. The significant changes are indicated by vertical lines in the left-hand margins of the 1972 specification, TID-25875 (EUR 4100e, 1972). Questions arise regarding compatibility of equipment built to the new specification with older equipment. In the following, the significant changes are examined point by point, and the compatibility aspects of each are discussed.

The prefix "(69)" refers to equipment designed in accordance with the 1969 version of the CAMAC specification. The prefix "(72)" refers to equipment designed to comply with the 1972 version. Crate Controllers Type A (69) are those built in conformance with preliminary versions of EUR 4600e. Crate Controllers Type A (72) conforming to TID-25876 (EUR 4600e, 1972), are designated Type A-1.

The discussion is based on the assumption that the CAMAC system is used in a "normal" manner -- i.e., all the CAMAC rules are obeyed. It is also assumed that the CAMAC system is controlled by a computer.

2.0 Summary of compatibility aspects

Compatibility may be examined on several levels. At the mechanical level are the considerations of mechanical interchangeability of crates, plug-ins, etc. At the Dataway level, one asks if individual Dataway operations can be carried out successfully. At the System level, one may be concerned with the operation of algorithms --sequences of CAMAC and computer operations--either in the hardware of a controller or in the software of a computer.

The following summary statements may be made regarding each of these levels:

Mechanical level: There are no changes in the CAMAC specification that affect the mechanical compatibility of modules and crates.

Dataway level:

1) For a system in which (72) modules are included with (69) modules in a (69) system -- i.e., (69) crates and (69) crate controllers--there are no specification changes that abrogate the ability to execute any Dataway command. Obviously, some of the benefits of the (72) modules' features may not be fully realized in the (69) system.

2) When (69) modules are used in a (72) system, all features of the (69) modules are still usable with one possible exception. This occurs if the (69) modules use patch pins P1 or P2. (This should not affect the ability to carry out Dataway operations since "Patch connections must not be essential for the operation of the main features of general-purpose units"--Sec. 5.6.2)

Systems level:

1) When (72) modules are used in a (69) system, the only compatibility problem (software level) concerns the new definitions of F(18) and F(19).

2) When (69) modules are used in a (72) system, the only compatibility problems concern the X-line (hardware) and new definitions of F(18) and F(19) (Software).

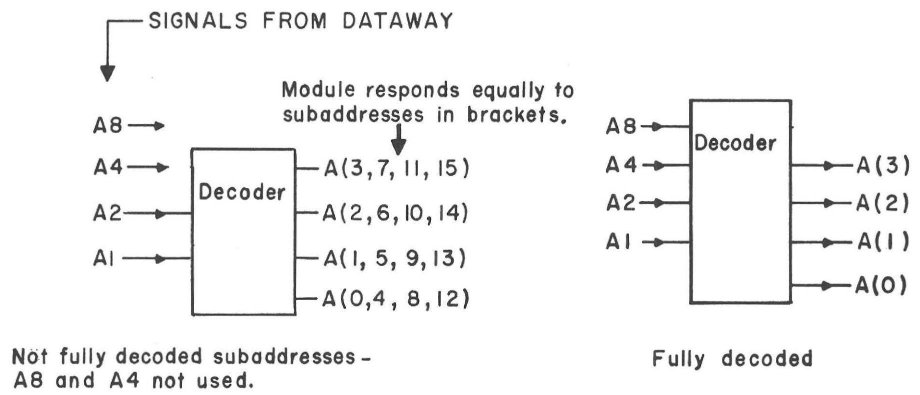
3) Crate Controllers Type A (69) are not compatible with the use of the X-line.

3.0 Detailed Comparisons

3.1 Full decoding of F and A codes (5.1.2 and 5.1.3)

Differences: CAMAC (72) requires that all F and A codes be unambiguously decoded, by using all five F and all four A lines in the decoding process.

Reason: If F and A codes are not fully decoded, the module may accept commands that it was not intended to accept. The possibility is illustrated below.



Compatibility problems: None

3.2 Gating of L signals in modules (5.4.1)

Differences: CAMAC (69) required that, within the module, the L signal be gated off by Busy. The consequence of this provision is that any Dataway command operation, directed to any module in the crate, gates off the L signals from all modules. CAMAC (72) requires that L be gated off by N, or by N in conjunction with selected A and F codes. The result is that an L from a given module is gated off only by commands directed to that module. All other L's are unaffected.

Reason for change:

a) In general, permits the controller to recognize the presence of L's with less time delay;

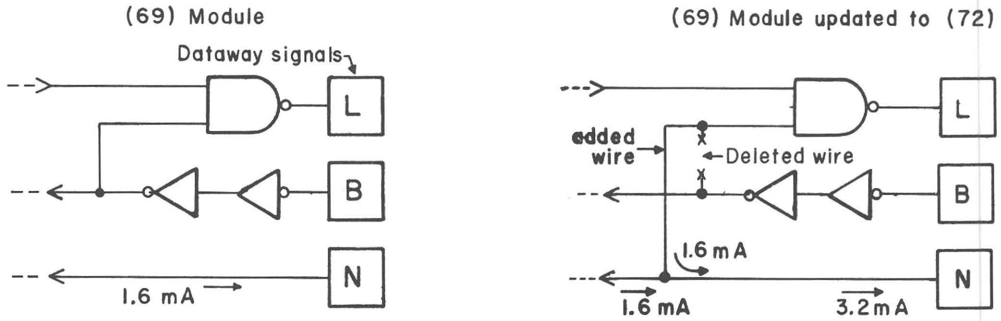
b) Allows L requests to be recognized even when there is a contiguous series of Dataway commands.

Compatibility: Conflicts should only arise on the systems level.

1. Modules. The L requests from (69) modules may be recognized and acted upon more slowly than those from (72) modules. Otherwise there should be no operational problems when (69) and (72) modules are mixed in a system.

2. Controllers. Either (69) or (72) controllers work with (69) or (72) modules.

Updating: The Dataway current specification (Table VI) has been changed to permit a module to draw 3.2 ma from N. This permits modules to be updated as shown in the example below:



3.3 Testing of L signals and LAM sources (5.4.1.1)

Differences: With Function Code F(8), CAMAC (69) provided the means of testing the status of individual sources of Look-at-Me demands.

CAMAC (72) now requires that some means of testing the individual sources be designed into any module with more than one source. This means may be either F(8) commands or the parallel-access LAM status register.

In addition, CAMAC (72) requires that any module capable of generating an L signal must include a means of testing the state of the L by an F(8) operation.

Reason for changes: Software for finding the source of an L-request can more easily be written if these features exist uniformly.

Compatibility aspects: There are no compatibility problems, except possibly at the software level.

3.4 Resetting of LAM sources (5.4.1.1)

Differences: CAMAC (72) prohibits the spontaneous resetting of a LAM source within a module if an L=1 signal is being generated by the module. "Spontaneous" refers to voluntary actions of the module which are not the result of Dataway command cycles or Initialize.

Reason for the change: This change is primarily for the benefit of software. The initiation of an L=1 generally triggers a software (or, sometimes, hardware) action designed to perform the appropriate response. Sometimes the action involves a search to find the LAM source that originated the L. If the source is reset before it is found, the "searcher" may be confused unless it is designed to cope with this situation.

Compatibility aspects: Problems should arise only on the systems level. They should arise only if the computer software or controller hardware is unable to cope with a search that fails to find a LAM request.

Updating: It may be possible to alter offending (69) modules such that they do not spontaneously reset LAM sources.

3.5 Parallel access features for modules with several LAM sources (5.4.1.2)

Differences: Some modules contain several sources of LAM requests. Since there is only one L signal per station, means of identifying which LAM source caused the L signal must be included in these modules. CAMAC (69) defined test and control commands, F(8), F(10), etc., in which each LAM source was assigned a specific sub-address. Thus, by performing a series of F(8) Dataway command cycles, the source of an L signal may be identified.

In addition, CAMAC (72) defines optional registers that may be used to test and control up to 24 individual LAM source channels. Each LAM channel within the module is associated with a bit of the register word. Since these registers can be read or loaded with a single Dataway command cycle, the process of identifying or controlling the LAM source takes less Dataway time than if the sub-address controlled search is done. CAMAC (72) defines the preferred addresses of these registers.

Reason for including alternative features: They permit faster identification of the reason for an L request from a module with many LAM sources.

Compatibility aspects: No compatibility problems exist, since the alternative features are accessed by standard Dataway commands.

Updating: Generally, updating is neither feasible nor necessary.

3.6 Use of Q for Block Transfers (5.4.3.1, 5.4.3.2, 5.4.3.3)

Changes: CAMAC (69) defined the use of Q for accessing sequentially-addressed registers. (This information was located in Sections 6.1 and 6.3)

CAMAC (72) retains exactly the same sequential-address definition, but has given it a new name, "Address Scan." In addition, two other modes of using Q for block transfers are defined--Repeat mode and Stop mode.

Reason for changes: Experience showed the need for block transfer modes in addition to Address Scan.

Compatibility Aspects: A compatibiltiy discussion is complicated because the Repeat mode (R) and Stop mode (S) block transfers were not illegal under CAMAC (69). Likewise, it is not mandatory, under CAMAC (72), that controllers be implemented for R, S or Address Scan (A) modes, and it is purely the designer's choice if a module uses any or all of R, S, or A modes.

1. Modules and Dataway. All block transfers are accomplished using completely standard CAMAC cycles. There is no incompatibility between modules and Dataway.

2. System controllers and Dataway. For the same reason there is no incompatibility between system controllers and Dataway.

3. Modules and System controllers. There can exist an incompatibility at the system level if the system controller cannot perform the algorithm associated with the block transfer mode. However, essentially all computer-operated system controllers can do any of the block transfer algorithms under program control, even if they can't do them under hardware (Direct-memory access) control.

3.7 Command Accepted (X) (5.4.4)

Changes: CAMAC (69) specified that one of the Dataway bus-lines (X) be reserved for future allocation.

CAMAC (72) allocates this bus-line to carry the Command Accepted signal.

Reason for change: Some systems need a signal that indicates immediately the acceptance of a command by the addressed module. These include those systems where the correct execution of commands is critical to the safety or integrity of the system. The Command Accepted signal is made more significant by the mandatory requirement for full decoding of A and F.

Compatibility aspects: In the following, it is assumed that (72) system controllers will be capable of monitoring the X-line and of alerting the system if an X=0 response occurs during any Dataway command cycle. It is also assumed that (72) system controllers will be capable of disabling the X-line monitoring upon command. (This will be essential for operations such as Address Scan.) Note that Crate Controllers Type A-1 contain the necessary logic for the X-signals.

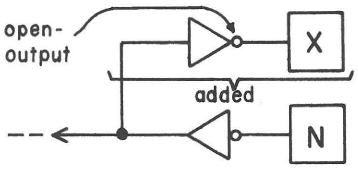
1. There is no compatibility problem with any mixture of modules, Crate Controllers Type A or A-1, or System Controllers if the alarm resulting from X=0 is disabled.

2. (69) System Controllers and (69) Crate Controllers (including Crate Controllers Type A) ignored the X signal. Therefore, systems with (69) controllers have no compatibility problem with (72) modules.

3. A problem arises if (69) modules are used with (72) System Controllers and Crate Controllers Type A-1. (72) system controllers will need to disable their X-line monitoring when addressing (69) modules, since these modules always respond with X=0.

Updating:

1. (69) modules can be partially updated by setting X=N as in the sketch. (This modification does not satisfy the (72) CAMAC specification for new designs.) Modules so modified generate X=1 when addressed by any function code, valid or invalid. (72) system controllers would not need to disable the X alarm when addressing such a module.



2. Full updating of (69) modules, Crate Controllers Type A (69), and System Controllers may not be worthwhile unless it is necessary to use them in systems where the X signal must be utilized.

3.8 Initialize (Z) and Inhibit (I) (5.5.1 and 5.5.2)

Changes:

1. (72) CAMAC requires that I=1 be generated whenever Z=1. In all units that generate I from a flip-flop, Z must set the flip-flop into the state that generates I=1.

2. (72) CAMAC requires that modules gate Z with S2, whereas (69) CAMAC only recommended it.

Reasons for changes:

1. Previously there was a risk that Z and I might not overlap. The change specifies timing such that I is generated reliably within the duration of the Z signal.

2. Initialize is intended to be used primarily during system start-up. Setting I=1 with Z is consistent with this.

3. Gating Z with S2 gives improved noise immunity against accepting false Z signals.

Compatibility problems: None expected

3.9 Gating of Clear (C) with S2 (5.5.3)

Changes: (72) CAMAC requires that modules gate C with S2, whereas (69) CAMAC only recommended it.

Reason for changes: Improved noise immunity.

Compatibility problems: None expected.

3.10 Free bus-line (5.6.1)

Changes: (69) CAMAC provided 5 patch points (P1,...P5) at all normal stations. In (72) CAMAC, two of these points have been allocated to two free bus-lines. Thus each normal station now has three patch points and two free bus-line connections.

Reasons for change : For some users a freely available bus-line is more convenient than patch points which have to be interconnected.

Compatibility aspects: If (69) modules or crate controllers are used in (72) crates, they should be checked to see if patch pins P1 or P2 are used. If so, the module may need to be modified. If P1 and P2 are not used, there is no compatibility problem.

3.11 Module Characteristic (6.)

Changes: (72) CAMAC recommends that, if a register location is assigned to the function of module description (Module Characteristic), the location should be Group 2 A(15).

Reason for change: Some modules already include module characteristic registers. From the software view-point, it is beneficial to have all such registers at the same relative address.

Compatibility aspects: No problems except possibly at software level.

3.12 Definition of Clear Look-at-Me F(10) (6.2.3)

Changes: (69) CAMAC required that the Q response during F(10) represent the state of the L source (before cleared). (72) CAMAC removes this requirement and says Q may indicate the status of any selected feature in the module.

Reason: Under the (69) specification, the module and controller may not agree on the state of the Q response if it changes near S1. In (72) CAMAC, the functions of clearing and testing LAM are separated into Clear LAM F(10), Test LAM F(8) and Test Status F(27).

Compatibility problems: No problems except possibly at software level.

3.13 Changes in definitions of Function Codes F(18), F(19), F(21) and F(23) (6.3.3, 6.3.4, 6.3.5 and 6.3.6)

Differences:

Function Code	Designation in CAMAC (69)	Designation in CAMAC (72)
F(18)	Selective Overwrite, Group 1	Selective Set, Group 1
F(19)	Selective Overwrite, Group 2	Selective Set, Group 2
F(21)	Reserved	Selective Clear, Group 1
F(23)	Reserved	Selective Clear, Group 2

The old Selective Overwrite meant write ones or zeros (jam transfer) into the selected bits of the addressed register. The bits were selected by an additonal mask register. The new Selective Set command is very similar to the OR command in most computers. It can only set a bit in the addressed register; it never resets. The new Selective Clear command accomplishes the inverse; it can only reset a bit, and never sets.

Reasons for changes: The changes in definitions of F(18) and F(19) are feasible only because there has been very little use of these commands in module design. The new definitions are used in the newly-defined parallel-access Look-at-Me structure (See 5.4.1.2). In particular, they simplify the task of selectively setting or resetting bits in the LAM source and LAM mask registers. They are equally useful in performing similar operations in other areas.

Compatibility aspects: Compatibility conflicts arise only on the software level if (69) and (72) modules, both using F(18) and F(19), are in the same system. If so, they respond differently to these commands.

3.14 New name for Function Code F(25) (6.4.2)

Difference: In CAMAC (69), F(25) was called "Increment Preselected Registers". In CAMAC (72) it is called "Execute". In addition, the permitted usage of the command has been broadened.

Compatibility Problems: None

3.15 Digital signals on the Dataway (7.1)

Changes and Compatibility aspects:

1. CAMAC (72) requires all signals to be delivered through intrinsic OR (open-collector) gates. Previously the Inhibit line was an exception. No compatibility problems as long as there is only one source of the I signal in a crate.

2. CAMAC (72) puts a lower limit of 10nsec on rise and fall times of Dataway signals. This number is consistent with normal TTL IC logic. Faster transitions may cause cross-coupling. No compatibility problems.

3. The maximum current drawn from the N line by a module has been increased from 1.6 mA to 3.2 mA. This will aid in updating older modules for L gating or X response. No compatibility problems.

4. The pull-up currents, I_p, for the S1 and S2 lines have been raised from $6 \leq I_p \leq 9.6$ to $38 \leq I_p \leq 58$ mA. This provides faster trailing-edge transitions of these signals, and helps to reduce the possibility of cross coupling onto S1 and S2 from other signals. No compatibility problems.

3.16 Timing of Unaddressed Dataway Operations (7.1.3 and Fig. 10)

Changes: The (69) specification required that S2 and B accompany unaddressed operations Z and C. However, the relative timing was not explicitly stated. The (72) version includes a specification of the timing associated with these operations.

Compatibility: No compatibility problems should arise if, in designing (69) modules, the designers made reasonable assumptions regarding Z and C timing, based on an examination of Fig. 9.

3.17 Changes in voltage tolerances for +12V, -12V, +24V, -24V (Table X)

Differences: The tolerances for these voltages have been changed from ±0.5% to ±1.0%.

Reason: This figure more accurately portrays the voltage delivered to the modules in a typical system. It informs the module designer of the voltage tolerances he must expect. Note that the power supply must have a tolerance lower than ±1.0% in order that the voltage at the connector be within the specified range.

Compatibility: No problems.

Appendix G

Summary of the Main Differences Between EUR 4600e and the Preliminary Issue (November 1970)

1. The Reserved Lines BX9 and BX9(R) are now allocated to the cable screen, with mandatory grounding in units that terminate the signal lines, and optional grounding in other units. (Section 6.1)

2. The Reserved Line BX8 is now allocated to the Command Accepted signal BX, derived from the Dataway X line and from Crate Controller Type A. (Sections 4.2.3 and A1.8)

3. The designations of the remaining seven Reserved Lines are now BV1 to BV7. (Tables I, VI and VII)

4. The transition time of the BD signal is reduced from 400±200 ns to 100±50 ns. (Section 4.4.1)

5. The maximum delay between an L signal transition and the corresponding BD signal transition is now defined as 400 ns, of which not more than 250 ns is due to Crate Controller Type A. (Sections 4.4.1 and A1.9.2)

6. The Dataway Inhibit signal (I) is now established before t_3 when Crate Controller Type A generates Z, in order to meet the requirement of EUR 4100e (1972). (Section A1.5.3)

7. It is now emphasised that other methods of interconnection of crates are permitted, including methods using crate controllers dedicated to specific computers.

8. Crate controllers conforming to this final specification and EUR 4100e (1972) may use the designation Crate Controller Type A-1 (CCA-1). (Footnote to Section 1)

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