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May 1984
to

Publication 516
1975

**Système modulaire d'instrumentation pour le traitement de l'information ;
système CAMAC**

**A modular instrumentation system for data handling ;
CAMAC system**

Les modifications contenues dans le présent document ont été approuvées suivant la Règle des Six Mois.

Le projet de modifications, discuté par le Comité d'Etudes n° 45, fut diffusé en janvier 1983 pour approbation suivant la Règle des Six Mois, sous forme de document 45(Bureau Central)167.

The amendments contained in this document have been approved under the Six Months' Rule.

The draft amendments, discussed by Technical Committee No. 45, were circulated for approval under the Six Months' Rule in January 1983, as Document 45(Central Office)167.



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Page 3

Add the following text to the contents page:

— under "Clause":

10. Use of supplementary 6 V power (Bus-lines Y1, Y2)

— under "Figures":

11. Some LAM structure options

12. Typical current sharing with supplementary 6 V power

Page 17

4.4 The Dataway

Delete last sentence of last paragraph: "Relatively high voltages ... neutral).".

Page 19

TABLE I

Replace the last entry by the following:

Additional power lines			
+12 V d.c.	+12	1	
-12 V d.c.	-12	1	
Clean earth	E	1	Reference for circuits requiring clean earth
Supplementary -6 V	Y1	1	See Clause 10
Supplementary +6 V	Y2	1	See Clause 10
Reserved	Undesignated	3	

Pages 21 and 23

TABLES II and III

Replace the last entry by the following:

Power bus-lines	{	-12 V d.c.	-12	-24	-24 V d.c.	{	Power bus-lines
		Reserved (c)*	-	-6	-6 V d.c.		
		Reserved (a)*	-		Reserved (b)*		
		Supplementary -6 V**	Y1	E	Clean earth		
		+12 V d.c.	+12	+24	+24 V d.c.		
		Supplementary +6 V**	Y2	+6	+6 V d.c.		
		0 V (power return)	0	0	0 V (power return)		

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Add below Tables II and III:

- * Reserved (c) was previously assigned to +200 V d.c.,
Reserved (a) to 117 V a.c. line and,
Reserved (b) to 117 V a.c. neutral.
These assignments have been cancelled in order to avoid hazardous voltages on the connectors.
- ** See Clause 10.

Page 25

5.1.1 *Station number (N)**Add to last paragraph:* “and the design of the modules should permit this.”.

Page 37

5.7 *Power lines**Replace the existing text by the following:*

The Dataway shall include lines for all the mandatory and additional power supplies shown in Table I.

The Dataway need not include lines for the supplementary +6 V and –6 V supplies (Y2 and Y1), but its construction should be such that bus-lines and wiring in accordance with Clause 10 can be installed on Y1 and Y2 if required.

Details of the voltage tolerances and permitted loadings of the power lines are given in Clause 8.

Page 45

7.1.2 *Current standards for Dataway signals**Add the following new paragraph:*

There is no restriction on the number of modules that can be addressed simultaneously (see Sub-clause 5.1.1). The signal output from modules to the Dataway Q, R, and X lines should therefore be capable of operating in intrinsic OR mode (see Sub-clause 7.1). Thus, it should be possible for one module to drive a line to the logic “1” state while all other modules are generating logic “0” outputs to the same line.

8. Power line standards

At the end of the second paragraph add: “(See also Clause 10).”.

Replace the third paragraph by the following:

The additional lines are required for special requirements, for example, compatibility with the NIM system. There are heavy current lines for +12 V and –12 V d.c. and a low current line for an independent and isolated clean earth (ground) return E. The 12 V lines are not necessarily powered unless specifically required for use.

Add Clause 10, as follows:

10. Use of supplementary 6 V power (bus-lines Y1, Y2)

In special cases, plug-in units may be used that draw more than 3 A at +6 V or –6 V.

Such plug-in units are considered special, but they shall comply with the current rating for Dataway connector contacts as given in Note 1 of Table X. The total power dissipation in the station or stations occupied by the plug-in unit shall be consistent with Note 3 of Table X.

They shall draw their excess (supplementary) 6 V power, not to exceed 3 A per contact, through the Y1 and Y2 contacts. The total return current in each 0 V contact, including any current from the 24 V and 12 V lines, shall not exceed 3 A per contact.

In order to meet this requirement, the current distribution between the two 0 V contacts may need to be controlled. An example of a suitable circuit is shown in Figure 12.

Plug-in units requiring supplementary 6 V power should only be installed in special crates in which the Y1 and Y2 contacts are bussed and wired to provide the necessary power (see also Sub-clause 5.7).

Plug-in units requiring supplementary 6 V power shall have the supplementary (Y1, Y2) voltage and current requirements clearly and permanently marked on the front panel.

Crates equipped with Y1 and Y2 bus lines and wired for supplementary 6 V power shall be clearly marked to indicate this.

The mandatory front panel marking showing supplementary power requirements should be reinforced by a conspicuous warning on the plug-in unit (for example, on the side panel), indicating that it can only be used in crates equipped with Y1 and Y2 supplementary power).



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Replace Table X by the following:

TABLE X
Power line standards

Nominal voltage on power line in crate	Voltage tolerance at Dataway connectors	Maximum current loads	
		In the plug-in (per unit width) See Notes 1 and 3 (A)	In the crate See Note 2 (A)
Mandatory			
+24 V d.c.	$\pm 1.0\%$	1 A	6 A
+6 V d.c.	$\pm 2.5\%$	2 A*	25 A*
-6 V d.c.	$\pm 2.5\%$	2 A*	25 A*
-24 V d.c.	$\pm 1.0\%$	1 A	6 A
0 V			
Additional (as required)			
+12 V d.c.	$\pm 1.0\%$		
-12 V d.c.	$\pm 1.0\%$		

1) The current carried by each contact of the Dataway connector must not exceed 3 A.

2) The total power dissipation in a crate without forced ventilation must not exceed 200 W.

3) The power dissipation in each station must not exceed 8 W in general or 25 W under special circumstances.

* See Clause 10.

Page 60

In Figure 5, add the following Note 6:

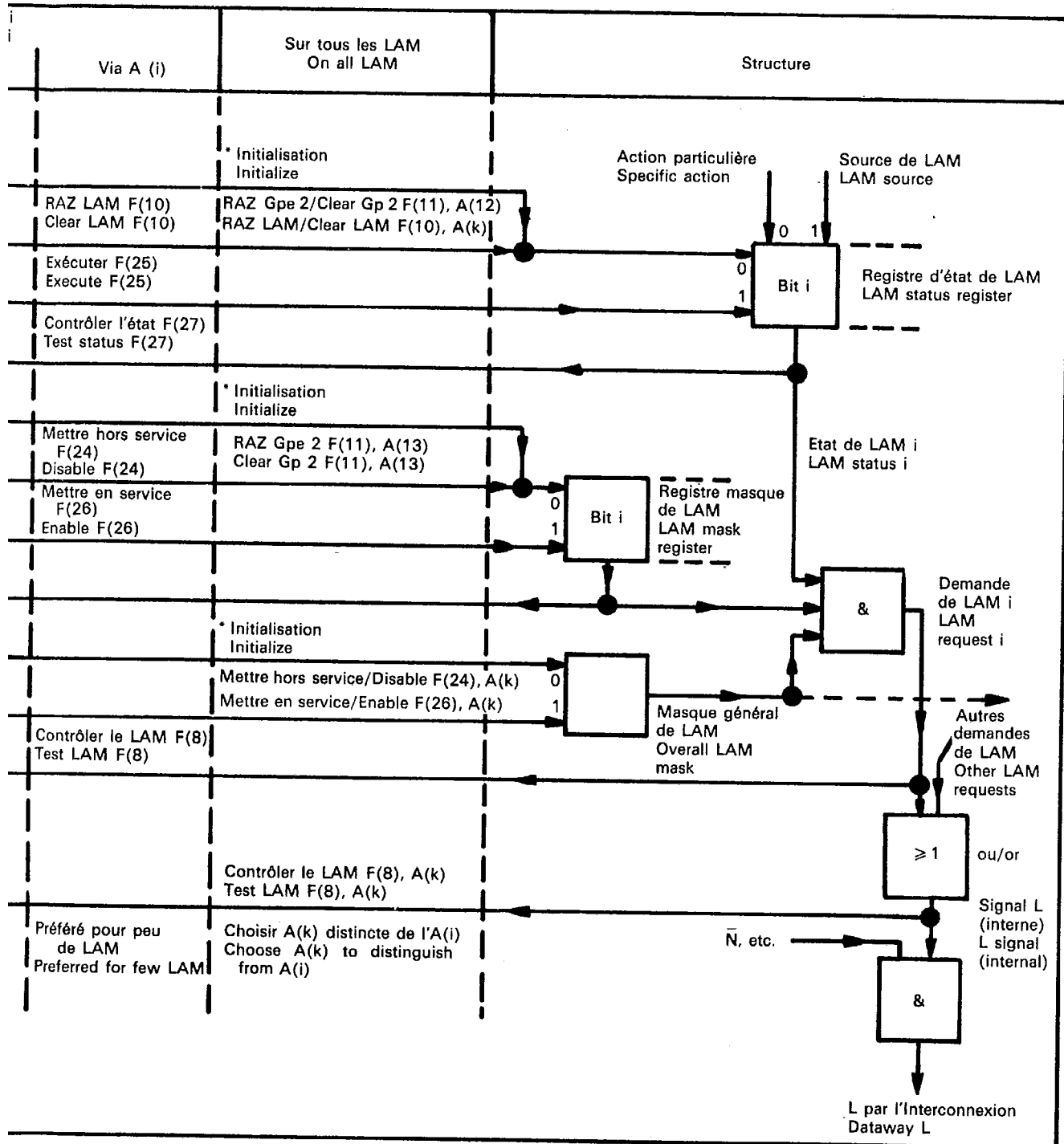
6. — A chamfer of 0.3 mm max. $\times$ 0.3 mm max. is permitted on the two vertical edges of the connector even though Section a-a of 5.2 shows zero chamfer.

Pages 64 and 65

In Figures 9 and 10, add the following Notes 5 and 6:

5. — For all signals the minimum rise or fall time is 10 ns. See Sub-clause 7.1.
6. — Signal transition at t_0 or t_2 may be absent if the signals on command or data lines are the same for the immediately preceding or following operations. See Sub-clause 7.1.3.1.

After page 65, add the following new Figures 11 and 12:



033/84

FIG. 11. — Quelques options de structure du circuit d'appel.

* Obligatoire (voir paragraphe 5.4.1.1).

Some LAM structure options.

* Mandatory (see Sub-clause 5.4.1.1).

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Publication 516

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système CAMAC**

**A modular instrumentation system for data handling;
CAMAC system**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**A MODULAR INSTRUMENTATION SYSTEM
FOR DATA HANDLING;
CAMAC SYSTEM**

FOREWORD

- 1) The formal decisions or agreements of the IEC on technical matters, prepared by Technical Committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.
- 2) They have the form of recommendations for international use and they are accepted by the National Committees in that sense.
- 3) In order to promote international unification, the IEC expresses the wish that all National Committees should adopt the text of the IEC recommendation for their national rules in so far as national conditions will permit. Any divergence between the IEC recommendations and the corresponding national rules should, as far as possible, be clearly indicated in the latter.

PREFACE

This publication has been prepared by IEC Technical Committee No. 45, Nuclear Instrumentation.

A first draft was prepared according to document EUR 4100e published in 1972 by ESONE Committee and describing the CAMAC system, a modular system widely used in nuclear laboratories throughout the world for data handling in measurement and control situations.

This draft was discussed at the meeting held in The Hague in 1973, as a result of which the draft, document 45(Central Office)83, was submitted to the National Committees for approval under the Six Months' Rule in February 1974.

The following countries voted explicitly in favour of publication:

Belgium	Poland
Czechoslovakia	Romania
Denmark	South Africa (Republic of)
Finland	Switzerland
France	Turkey
Germany	Union of Soviet
Israel	Socialist Republics
Italy	United Kingdom
Japan	United States of America
Netherlands	Yugoslavia

Other IEC publications quoted in this publication:

- Publications Nos. 297: Dimensions of Panels and Racks (for Nuclear Electronic Instruments).
482: Dimensions of Electronic Instrument Modules (for Nuclear Electronic Instruments).

A MODULAR INSTRUMENTATION SYSTEM FOR DATA HANDLING; CAMAC SYSTEM

1. Object

This publication is intended to define a modular instrumentation system capable of linking transducers and other devices with digital controllers or computers. It consists of mechanical standards and signal standards that are sufficient to ensure compatibility between units from different sources of design and production.

The basic features of CAMAC are summarized as follows:

- a) It is a modular system, with functional units which can be combined to form equipment assemblies.
- b) The functional units are constructed as plug-in units and are mounted in a standard crate.
- c) The mechanical structure is designed to exploit the high component packing density possible with integrated circuit packages and similar devices.
- d) Each plug-in unit makes direct connection to a standard Dataway. This highway forms part of the crate and conveys digital data, control signals and power. The standards of the Dataway are independent of the type of plug-in unit or computer used.
- e) The system has been designed so that an assembly consisting of a crate and plug-in units can be connected to an on-line digital computer. However, the use of a computer is entirely optional and no part of this specification depends upon its presence in the system.
- f) External connections to plug-in units may conform to the digital or analogue signal standards of associated transducers, computers, etc., or to the requirements given in this publication for digital signals.
- g) Several CAMAC crates (up to 7) may be interconnected by the CAMAC branch highway.¹⁾

In order to claim compatibility with the CAMAC specification, any equipment or system must comply with the mandatory rules (see Sub-clause 3.1).

2. Scope

This standard applies to nuclear instrumentation but may be utilized also for other applications. Further IEC standards may indicate such extensions of this scope. For reactor instrumentation and control systems, other packaging of electronic nuclear instruments may also be used.

2.1 This standard applies to systems consisting of modular electronic instrument units that require input/output transfers for the purpose of digital data processing, normally in association with a form of common controller, computer or other automatic data processor.

2.2 This standard applies to word-serial transfers that involve the parallel transmission of up to, and including, 24-bits as a word between one of many sources and one of many acceptors of data.

2.3 This standard does not concern itself with the features, characteristics or requirements of the system inter-connection with the common controller, computer or other automatic data-processor, except in so far as these affect the operating conditions of the interface characteristics of the units.

¹⁾ The CAMAC branch highway is under consideration.

3. Terminology

3.1 Interpretation of this publication

Statements that specify mandatory aspects of the system are written in **bold type** and are usually accompanied by the word “shall”.

The word “should” indicates a recommended or preferred practice which is to be followed unless there are sound reasons to the contrary.

The word “may” indicates a permitted practice, leaving freedom of choice to the designer.

3.2 Definition of “module” and “controller”

In this standard, the terms “module” and “controller” refer to plug-in units whose use, if any, of each Dataway line is consistent with the following table. A controller occupies the control station (see Sub-clause 4.4) and at least one normal station. A module occupies one or more normal stations. A plug-in unit may combine some features of a module with some of a controller.

Line	Use by a module	Use by a controller
A	Receives	Generates
B	Receives	Generates
C	Receives	Generates
F	Receives	Generates
L	Generates	Receives
N	Receives	Generates
Q	Generates	Receives
R	Generates	Receives
S	Receives	Generates
W	Receives	Generates
X	Generates	Receives
Z	Receives	Generates

4. Mechanical characteristics

CAMAC is a modular system. Equipment assemblies are formed by mounting appropriate “plug-in” units in a standard chassis or “crate”. Each plug-in unit occupies one or more mounting “stations” in the crate. At each station there is an 86-way connector socket giving access to the “Dataway”, a data highway which forms part of the crate. The Dataway consists mainly of bus-lines for data, control and power.

Drawings for the manufacture of CAMAC compatible crates and plug-in units may be derived from the definitive dimensions given in Figures 1 to 3, pages 56 to 58, for crates, Figure 4, page 59, for plug-in units, and Figure 5, page 60, for Dataway connector plugs and sockets.

Recommended dimensions for ventilated crates, NIM adaptors and printed wiring cards for plug-in units are given in the non-mandatory Figures 6 to 8, pages 61 to 63, respectively.

All dimensions in these figures are in millimetres unless otherwise indicated.

4.1 The crate

The crate mounts in a standard 19-inch rack and has up to 25 stations for plug-in units on a pitch of 17.2 mm. Each station has upper and lower guides for the runners of a plug-in unit, an 86-way Dataway connector socket, and a tapped hole for the fixing screw of a plug-in unit.

Normal CAMAC plug-in unit described in Sub-clause 4.2 is the type C module of IEC Publication 482, Dimensions of Electronic Instrument Modules (for Nuclear Electronic Instruments). Furthermore Type N module of this IEC Publication (NIM module) can also be mounted in the crate on their basic pitch of 34.4 mm (see Sub-clause 4.3).

Unless otherwise indicated, all crates shall conform to Figures 1 to 3 and those parts of Figure 5 defining the connector socket.

Sub-clauses 4.1.1 and 4.1.2 are comments on these figures.