SLOVENSKI STANDARD

SIST HD 374 S2:2003

april 2003

CAMAC - Organization of multi-crate systems - Specification of the Branch-highway and CAMAC crate controller Type A1

ICS 27.120.99; 35.240.99

Referenčna številka
SIST HD 374 S2:2003(en)

CENELEC

Rue Bréderode, 2 - Bte 5 - 1000 Bruxelles
Tel 02-519 68 71 - Telex 26257
~~Telefax (+32 2) 519 68 19 - Teletex 206 2210097~~

HD 374 S2

ENGLISH VERSION

UDC :

KEY WORDS :

CAMAC - ORGANISATION OF MULTI-CRATE SYSTEMS. SPECIFICATION OF THE BRANCH-HIGHWAY AND CAMAC CRATE CONTROLLER TYPE A1

Système CAMAC - Organisation de systèmes multichâssis. Spécification de l'Interconnexion de branche et du contrôleur de châssis type A1

CAMAC - Organisation von Mehrrahmensystemen - Spezifikation der Branch-Verbindung und der CAMAC-Rahmensteuerung Typ A1

BODY OF THE HD

The Harmonization Document consists of:

- IEC 552 (1977) ed 1 + Amdt 1 (1984) ;IEC/TC 45, not appended

This Harmonization Document was approved by CENELEC on 1986-02-27

The English and French versions of the HD are provided by the text of the IEC publication and the German version is the official translation of the IEC text. The German translation is not yet available.

According to the CENELEC Internal Regulations the CENELEC member National Committees are bound :

to announce the existence of this Harmonization Document at national level by or before 1986-07-01

to publish their new harmonized national standard by or before 1987-07-01

to withdraw all conflicting national standards by or before 1987-07-01

Harmonized national standards are listed on the HD information sheet, which is available from the CENELEC National Committees or from the CENELEC General Secretariat.

The CENELEC National Committees are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom.

NORME INTERNATIONALE

INTERNATIONAL STANDARD

CEI
IEC
60552

Première édition
First edition
1977-01

Système CAMAC – Organisation de systèmes multichâssis
Spécification de l'Interconnexion de branche et du contrôleur de châssis type A1

CAMAC – Organization of multi-crate systems
Specification of the branch-highway and CAMAC crate controller Type A1

International Electrotechnical Commission 3, rue de Varembé Geneva, Switzerland
Telefax: +41 22 919 0300 e-mail: inmail@iec.ch IEC web site http: //www.iec.ch

Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

CODE PRIX
PRICE CODE W

Pour prix, voir catalogue en vigueur
For price, see current catalogue

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

CAMAC — ORGANIZATION OF MULTI-CRATE SYSTEMS SPECIFICATION OF THE BRANCH-HIGHWAY AND CAMAC CRATE CONTROLLER TYPE A1

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 recommendation and the corresponding national rules should, as far as possible, be clearly indicated in the latter.

PREFACE

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

A first draft was prepared according to document EUR 4600e published in 1972 by the ESONE Committee and giving additional features of the CAMAC system defined in IEC Publication 516.

This draft was discussed at the meeting held in Milan in 1974. As a result of this meeting, a draft, Document 45(Central Office)92, was submitted to the National Committees for approval under the Six Months' Rule in July 1975.

The following countries voted explicitly in favour of publication:

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

Other IEC publications quoted in this standard:

Publications Nos. 482: Dimensions of Electronic Instrument Modules (for Nuclear Electronic Instruments).
516: A Modular Instrumentation System for Data Handling; CAMAC System.

CAMAC — ORGANIZATION OF MULTI-CRATE SYSTEMS SPECIFICATION OF THE BRANCH-HIGHWAY AND CAMAC CRATE CONTROLLER TYPE A1

1. Introduction

1.1 *General*

The Advisory Committee on Electronics and Telecommunications (ACET) has recommended that Technical Committee No. 45 should be responsible for the introduction of IEC standards based on features of the CAMAC standard interface.

Those features of CAMAC that are specified in Document EURATOM Report EUR 4100e (1972) are contained in IEC Publication 516, A Modular Instrumentation System for Data Handling; CAMAC System.

The mechanical features of CAMAC plug-in units are additionally contained in IEC Publication 482, Dimensions of Electronic Instrument Modules (for Nuclear Electronic Instruments).

This standard defines those additional features of CAMAC in accordance with EURATOM document EUR 4600e (1972).

1.2 *Object*

IEC Publication 516 defines the basic features of the CAMAC modular instrumentation system capable of interfacing transducers and other devices with digital controllers and computers. The CAMAC Dataway, there defined, is the basis of the intercommunication system between modules and a controller within one physical assembly or crate. Multicrate systems can be organized as one or more larger structures, called branches, in which a Branch-highway provides the means of interconnection between the crate controllers in up to seven crates and a branch driver.

This standard is intended to define the signals, timing and logical organization of the connections from crate controllers and branch drivers to the Branch-highway through a defined 132-way connector.

Appendix A defines those features of a crate controller that affect hardware and software interchangeability. This appendix can be used either as the formal specification of a standard CAMAC crate controller Type A1 (CCA1), or as general recommendations intended to promote uniformity between crate controllers.

1.3 *Scope*

This standard applies generally to nuclear instrumentation and may be utilized also for other applications that require modular electronic instrument units to perform input/output signal transfers for the purpose of digital data processing, normally in association with a form of controller, computer or other automatic data processor.

For reactor instrumentation and control systems, other organizations of multi-crate systems may also be used.

a) In detail, this standard applies to systems consisting of CAMAC crates or CAMAC-compatible crates, containing modules and a controller, that need interconnecting with a bit-parallel Branch-highway. Further IEC standards may indicate extensions to this scope, to include for example a bit/byte-serial highway.

b) This standard applies to word-serial transfers that involve the parallel transmission of not more than 24 bits, as a word, between up to seven crates and one branch driver.

c) The specification and internal structures of crate controllers and branch drivers, and the physical nature of the Branch-highway itself are not the concern of this standard except where they affect compatibility between parts of the system and compatibility with crate controller Type A1.

In order to claim conformity with the specification of the CAMAC Branch-highway, any equipment or system must conform with all the mandatory statements in this standard, excluding Appendix A. Any equipment constructed as CAMAC plug-in units must also conform to the mandatory statements of IEC Publications 482 and 516.

In order to claim conformity with the specification of the CAMAC crate controller Type A1, an equipment must conform with all the mandatory statements in Appendix A of this standard.

Equipment connected to the Branch-highway need not conform fully to this specification, nor be constructed as CAMAC plug-in units. However, the minimum requirement is that all equipment connected to the Branch-highway must be compatible with, and not interfere with, full operation of all features of the Branch-highway and crate controllers as defined in this standard.

2. Interpretation of this standard

This publication should be read in conjunction with, and is supplementary to, IEC Publication 516. No part of this standard is intended to supersede or modify IEC Publication 516.

Statements that specify mandatory clauses are written in bold type and are usually accompanied by the word "must".

The word "should" is used to indicate a preferred practice which is to be followed unless there are good reasons to do otherwise.

The word "may" indicates good practice, but leaves freedom of choice.

The word "reserved" indicates that a feature must not be used until it has been more fully defined.

The word "free" indicates no restriction on the use of a particular feature within the constraints defined.

3. The branch

A multi-crate CAMAC system consists of one or more branches, each having a Branch-highway which is the means of interconnection between a branch driver and crate controllers. During each branch operation, the branch driver can communicate with a maximum of seven crate controllers.

All branch drivers and crate controllers have standard Branch-highway ports* by which they are connected to the Branch-highway. Each port consists of a 132-way connector (for 65 signals and their individual return lines, plus cable screen) with defined contact allocations and signal conventions. Each crate controller has two identical internally-linked ports in order to allow the branch to have the chain configuration shown in Figure 1, page 66. Other configurations are possible, such as shown in Figure 2, page 67, where the branch driver is not at the end of the branch and some crates are connected by only one port.

In addition to their normal "on-line" state, crate controllers have an "off-line" state which allows them to remain physically connected to the branch while ignoring (and not impeding) all branch operations. If required, the branch driver can recognize which crate addresses are associated with on-line crate controllers.

The basic mode of operation of the branch is the "command mode". The branch driver, which is typically associated with a system controller or computer, issues a command during each branch operation. This command includes crate address information to select one or more crate controllers. Each addressed crate controller accepts the command from the Branch-highway and generates the corresponding Dataway command (station number, sub-address and function). During "read" operation, data signals are generated by a module on the Dataway read lines, transferred to the data lines of the Branch-highway by the crate controller and accepted by the branch driver. During "write" operations, the branch driver generates data signals on the Branch-highway and these are transferred to the Dataway write lines by the crate controller and accepted by a module. During other command operations, there is no transfer of read or write data via the Branch-highway.

The branch has two "demand handling" features which allow the branch driver to respond to look-at-me signals from modules. For single-level demand handling, which merely indicates the presence of demands without identifying them, the crate controllers combine the look-at-me signals to form a common "branch demand" signal. For multi-level demand handling, which allows the branch driver to identify 24 different demands, there is the "graded-L mode" of branch operation. The branch driver issues a graded-L request (typically as the result of receiving the branch demand signal) and each on-line crate controller responds by selecting or rearranging its look-at-me signals to form a 24-bit graded-L word. The graded-L words from all crates are combined on the Branch-highway and presented to the branch driver.

At a Branch-highway port, the data lines are used in the command mode for information transfers in either direction between crate controllers and the branch driver. These lines are also used to convey the pattern of demands in the graded-L mode.

Transfers in either mode through a Branch-highway port are controlled by interlocking timing signals, which automatically adjust the timing of each branch operation to suit the actual transmission delays and controller performance that are encountered.

Initialize is the only "common control" signal that is transmitted through the Branch-highway port to the Dataway.

* In the sense that a port is "an entrance or exit of a network, etc.".

4. Use of lines at a Branch-highway port

Each line at a Branch-highway port must be used in accordance with the mandatory requirements detailed in the following sections. Table I shows the titles, the standard designations and the sources of the signals.

Lines at a port are distinguished from corresponding lines in the Dataway by the prefix B, e.g. the function code is carried by F lines in the Dataway and BF lines at a Branch-highway port.

4.1 *Command*

The command signals are used to control operations in the command mode, at which time the signal on the BG line (see Sub-clause 4.4.2) must be in the "0" state. They are transmitted by the branch driver on the BCR, BN, BA and BF lines at the Branch-highway port (see below).

TABLE I

Signal lines at Branch-highway ports

Title		Designation	Generated by	Signal lines	Use
Command	Crate address	BCR1 to BCR7	Branch driver	7	Each line addresses one crate in the branch
	Station number	BN1, 2, 4, 8, 16	Branch driver	5	Binary coded station number
	Sub-address	BA1, 2, 4, 8	Branch driver	4	As on Dataway A lines
	Function	BF1, 2, 4, 8, 16	Branch driver	5	As on Dataway F lines
Data	Read/write	BRW1 to BRW24	Branch driver (W) or crate controller (R, GL)	24	For read data, write data and graded-L
Status	Response	BQ	Crate controller	1	As on Dataway Q line
	Command accepted	BX	Crate controller	1	As on Dataway X line
Timing	Timing A	BTA	Branch driver	1	Indicates presence of command, etc.
	Timing B	BTB1 to BTB7	Crate controller	7	Each line indicates presence of data, etc., from one crate controller
Demand handling	Branch demand	BD	Crate controller	1	Indicates presence of demand
	Graded-L request	BG	Branch driver	1	Requests graded-L operation
Common control	Initialize	BZ	Branch driver	1	As on Dataway Z line
Reserved		BV6 and BV7		2	For future requirements
Free		BV1 to BV5		5	For non-standard user requirements

An individual return line is provided for each signal line. Two lines are provided for a connection to the screen, if any, of the Branch-highway cable.

4.1.1 *Crate addresses (BCR1 to BCR7)*

The seven crate controllers that can be addressed during any branch operation must each be associated with a different BCR line (although all Branch-highway ports have provision for all seven BCR lines).

Each crate controller must therefore include means, such as a switch or patch connection, for selecting the appropriate BCR line (referred to as BCR_i). The assignment of BCR lines to crates is not necessarily related to the physical arrangement of crates within the branch. The branch driver is permitted to generate signals simultaneously on more than one BCR line in order to select several crates for the same operation.

It is recommended that the crate controller should include a means of protection against spurious signals on the selected BCR line. For example, the incoming BCR signal or an internal signal derived from it may be conditioned by integration.

It will be seen later, in Sub-clause 4.3, that each crate controller is associated not only with one of the BCR lines, but also with the corresponding one of seven BTB lines.

The branch is not in a valid operating condition if more than one on-line crate controller is connected to the same BCR line. A means of reducing the risk of this occurring is suggested in Sub-clause 5.4.

4.1.2 *Station number (BN1, 2, 4, 8, 16)*

Signals on these five lines indicate the binary coded station number to be used within the selected crate or crates, and are decoded in the crate controller.

In a crate controller, the 32 codes are allocated as shown in Table II.

At least one normal station is occupied by the crate controller, and there are station number codes to address the remaining 23 normal stations individually. In addition there are codes to multi-address all normal stations or those stations indicated by the contents of a station number register (SNR). Two further station number codes address the controller and its extensions irrespective of their location in the crate.

TABLE II

Station number codes used in crate controllers

N Code	Use	B, S1 and S2	Remarks
N(0)	Reserved		
N(1) to (23)	Address the corresponding normal station	Yes	Normal stations occupied by the controller need not be addressed
N(24)	Address preselected normal stations	Yes	
N(26)	Address all normal stations	Yes	
N(28)	Address crate controller only	Yes	
N(30)	Address crate controller only	No	No Dataway operation
N(25, 27, 29, 31)	Reserved		

4.1.3 *Sub-address (BA1, 2, 4, 8)*

Signals on these four lines must be retransmitted on the Dataway sub-address lines (A1, 2, 4, 8) by an addressed crate controller whenever it is on-line during a command mode operation.

4.1.4 *Function (BF1, 2, 4, 8, 16)*

Signals on these five lines must be retransmitted on the Dataway function lines (F1, 2, 4, 8, 16) by an addressed crate controller whenever it is on-line during a command mode operation.

4.2 *Data and status*

4.2.1 *Read and write (BRW1 to BRW24)*

These 24 lines are used in command mode read operations to transmit data from the addressed crate controllers to the branch driver, with BRW1 corresponding to the Dataway R1, etc. They are also used in command mode write operations to transmit data from the branch driver to the crate controllers, with BRW1 corresponding to the Dataway W1, etc.

In the graded-L mode, they are used to transmit the pattern of demands from all on-line crate controllers in the branch to the branch driver. The generation of " 1 " state outputs to these lines is restricted to branch drivers during command mode write operations and to addressed on-line crate controllers during graded-L operations and command mode read operations.

4.2.2 *Response (BQ)*

During a command mode operation with an associated Dataway operation, each crate controller that is on-line and addressed must generate BQ corresponding to Dataway Q (BQ = Q). During a command mode operation that tests the status of a feature of the crate controller, without a Dataway operation, the crate controller must generate the appropriate BQ response. At all other times, crate controllers must generate BQ = 0. The signal on the BQ line at the branch driver is the OR combination of the signals from all crate controllers.

4.2.3 *Command accepted (BX)*

During a command mode operation with an associated Dataway operation, each crate controller that is on-line and addressed must generate BX corresponding to Dataway X (BX = X). During all other command operations, the crate controller must generate BX = 1 if it accepts the command and BX = 0 if it does not accept the command.

The signal on the BX line at the branch driver is the OR combination of the signals from all crate controllers.

a) Command accepted (X and BX) disabling

Crate controllers or branch drivers that include provisions for monitoring the 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 will permit normal operation of a system that may include early plug-in units that do not have provision for generating or transmitting the X and BX signals. Such 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.

b) Command accepted (BX) response to graded-L request (BG)

The generation of BX by CCA1 is fully defined for command mode operations (see Sub-clauses 4.2.3 and A8). Graded-L operations, however, are generally multi-addressed, in which case the BX signal at the branch driver is an unreliable indication that all crates have responded to the operation. Therefore the BX response to BG is not defined. However, it is recommended that:

1) When CCA1 is addressed in a graded-L operation, it should generate $BX = 0$.
2) During a graded-L operation, the branch driver should not respond to the state of the BX line.

4.3 *Timing (BTA, BTB1 to BTB7)*

The timing of all command mode and graded-L branch operations is controlled by branch timing signals. The branch driver initiates operations by signals on the common BTA line, and each addressed crate controller responds with a signal on its individual BTB line. All seven BTB lines are provided at each Branch-highway port, but each crate controller uses the line BTB_i corresponding to the line BCR_i by which it is addressed.

Each on-line crate controller must generate $BTB_i = 1$ when it is not addressed. The branch driver (and other crate controllers) can thus distinguish between BTB lines associated with on-line crates ($BTB_i = 1$) and off-line or absent crates ($BTB_i = 0$) (see Sub-clause 5.4).

The branch driver generates $BTA = 1$ to indicate that it is presenting a command or graded-L request at its port, and maintains the signal until it has accepted the resulting BRW or BQ information. Each crate controller generates $BTB_i = 0$ when it has established data or BQ information during branch operations.

The timing signals must be generated through intrinsic OR outputs and must have 10% to 90% signal transition times in the range 100 ± 50 ns.

It is recommended that the crate controller should include a means of protection against spurious signals on the BTA line; for example, the incoming BTA signal or an internal signal derived from it may be conditioned by integration. The full timing sequence is described in Clause 5.

4.4 *Demand handling*

Look-at-me (L) signals from units in any part of the branch typically demand that an appropriate command or sequence of commands be generated. The branch therefore has two demand-handling features, one associated with the branch demand signal and the other with the graded-L request signal.

4.4.1 *Branch demand (BD)*

Each crate controller can generate a demand signal, as any logical function of the L signals on the Dataway, through an intrinsic OR connection to the common branch demand line (BD). No restriction is placed on the time at which the BD signal may change, and therefore its 10% to 90% transition time must be in the range 100 ± 50 ns.

The delay between the time when an L signal at the control station of the crate controller reaches a maintained "1" or "0" state and the time when the BD signal at the Branch-highway port of the same crate controller reaches a corresponding maintained "1" or "0" state must not exceed 400 ns.

This maximum delay may be due partly to the crate controller and partly to some other unit involved in processing the L signals (for example, the LAM grader associated with crate controller Type A1). The maximum delay due to crate controller Type A1 is defined in Sub-clause A9.2.

4.4.2 *Graded-L request (BG)*

The branch driver initiates graded-L mode operations by generating the graded-L request signal (BG) accompanied by BCR signals to all on-line crates. Each addressed crate controller generates a 24-bit graded-L word on the BRW lines, and the branch driver reads the OR-combination of these words. The Dataway L signals in each crate are graded to select the relevant signals and assign them to the appropriate bits of the graded-L word.

The grading process may, for example, be organized so that the branch driver reads a word indicating which crates require attention, or which actions (such as program interrupts or autonomous transfers) are required. If the graded-L requests from the branch are arranged in priority order in the word, it is recommended, for uniformity, that a request on line BRW $(n + 1)$ should have priority over a request on BRW (n).

Crate controller Type A1 provides an additional means of access to the look-at-me information (see Sub-clause A9.4 and Table IX).

4.5 *Common controls*

4.5.1 *Branch initialize (BZ)*

The branch initialize signal (BZ) is generated by the branch driver and has absolute priority over all other signals in the branch. The normal branch timing signals are not used with BZ.

In order to allow crate controllers to discriminate against spurious signals of short duration, the branch driver must maintain BZ = 1 for a minimum of 10 µs. It must not generate a graded-L or command mode operation during the following 5 µs period.

4.5.2 *Dataway initialize (Z), clear (C) and inhibit (I)*

A crate controller receiving a branch initialize signal (BZ) whose duration exceeds a minimum value (specified as 3 ± 1 µs) must initiate the generation of Dataway initialize (Z) together with busy (B) and strobe (S2) as required by IEC Publication 516. The generation of S1, in addition to the mandatory B and S2, is optional and cannot be relied upon by other units connected to the Dataway.

All crate controllers must include some means of generating Dataway clear (C) and inhibit (I) signals.