Sample Program Using the Kinetic Systems
CAMAC Interface and PAW

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1 Introduction

The programs which read data from the prototypes for the drift chamber and time-of-flight scintillator counters use the Kinetic Systems Corporation Model 3922 Crate Controller, and 2922 Q-bus CAMAC Interface to the MicroVax II. Low level FORTRAN callable CAMAC interface routines are provided by the Kinetic System Corporation 6610-1B Software Support Package [1]. CALIB is a shell for an online program which reads ADC and TDC modules from CAMAC and histograms the charge and times made available to a skeleton analysis. The histograms are stored by HBOOK [2] into a global section which may be accessed and manipulated with the Physics Analysis Workstation (PAW) [3]. Additional graphics capabilities are supported with the H PLOT [4] and HIGZ [5] graphics interface utilities. We use the DCL Command Definition Utility to accept interactive commands which allow for rudimentary control of data acquisition and histogram display. CALIB was written to allow application-specific analysis to be made within a FORTRAN programing environment.

2 CALIB

2.1 Getting Started

In order to run the CALIB program, we recommend that the terminal be setup to display both text and graphic screens ("Both planes" for the GraphOn 235 terminal). Then define the logical name "CAL" to be [DEMO.CALIB]. Then set default directory to [DEMO.CALIB]. Then, to begin data acquisition, type in "RUN CALIB". It will take a minute for CALIB software to initialize both CAMAC and PAW interfaces. The software is ready to accept commands when the string 'CALIB>' is displayed on the screen. To initiate data acquisition type "RUN." The list of available commands can be listed with "HELP." Data acquisition is inhibited with the command "STOP." A listing of all commands is given in appendix A.

1These routines replace the CAMAC program EASY written by Peter Dunn.
2.2 CALIB Commands

The CALIB program consists of 13 commands which are used for online control, debug and display. Here we describe their general functionality. The syntax of the commands (see Appendices A and B) is prescribed by the VAX/VMS Command Language Interpreter which is used to accept terminal input.

2.2.1 Control

The commands of RUN, STOP, ERASE, EXIT, and RESET are used to enable and disable LAMs, clear the screen, and zero histograms and program counters. For example, to erase the text on the screen type "ERASE TEXT", to erase graphic displays type in "ERASE GRAPHICS," and if you want to erase both text and graphics, type in "ERASE BOTH." The default is "BOTH."

2.2.2 Debug

If you want to output the raw data as it is read from CAMAC, type "DEBUG ON." The CALIB software will type the raw TDC and ADC data. The display will be continued until you type in "DEBUG OFF." If the parameter is omitted, the program will prompt you for it.

2.2.3 Display

Most of the commands are used for display. The PLOT command will display either 1-dimensional or 2-dimensional histograms. Qualifiers to this command allow the histograms to be displayed with various options such as scatter, contour, lego or surface for 2-dimension histograms. The following are some pictures displayed by PLOT commands. For more details see appendix A. A useful command is BROWSE, which plots all defined histograms one at a time. The two commands META and HARDCOPY produce a metafile with plotted histograms which may then be sent to a laser printer. The following steps will produce a hardcopy of histogram 101 and sent by default to CB113.

   CALIB>META Open the metafile to printed.

2
CALIB>PLOT 101 Output histogram 101 to the 
screen and to the metafile.

CALIB>HARDCOPY Print the metafile.

Other display commands are HISTS, STATS and HELP. HISTS will make
a list of all defined histograms and STATS outputs a few run statistics to the
terminal. HELP lists all CALIB commands.

2.3 Dynamic Access to Histograms

The histograms defined by CALIB are stored in a global section which may
be dynamically accessed with PAW. The global section is named "CALIB." To run PAW on CEBAF3, set the terminal type to 72. To map to the global
section, type 'HISTOGRAM/HIO/GLOBAL_SECT CALIB'. This sets the
current PAW directory to //CALIB. We give an example how to map the
global section with PAW and plot four histograms (Identifiers 101-104) on a
single page.

PAW> OPTION STAT
PAW> OPTION DATE
PAW> HISTOGRAM/HIO/GLOBAL_SECT CALIB
PAW> META 10 70
PAW> ZONE 2 2
PAW> HISTOGRAM/PLOT 101
PAW> HISTOGRAM/PLOT 102
PAW> HISTOGRAM/PLOT 103
PAW> HISTOGRAM/PLOT 104

The output of this sequence of commands shown in Figure 1 is displayed on
the screen and stored in the file named PAW.METAFILE. If you want to get
a hardcopy on queue CB113, type in the command:

PRINT/SETUP=TEKON/NOFL/QUE=CBl13 PAW.METAFILE

Currently CEBAF3 and CEBAF2 are running different versions of PAW. The terminal
type and metafile number are different. The terminal type for CEBAF2 is 301400.

On CEBAF2 should be META 10 300018.

To print the metafile on queue CB113 on CEBAF2, use the CERN defined utility
MPLOT. The command is MPLOT PAW.METAFILE .8 CB113
Figure 1: Example of four histograms displayed with PAW.
3 How to modify CALIB

3.1 FORTRAN Source Code

The CALIB software is kept in the public directory DISK$CEBAF3SYS: [DEMO.CALIB]. The FORTRAN source file is CALIB.FOR, the executable image is CALIB.EXE and the Command Language Definitions are contained in CALIB.COMMAND.CLD. Various parameters are set in the data file CAL.INIT.DAT such as the graphics terminal type, slot number for LAM generation, etc. The command procedure CALIB.COM is used to compile and link the program.

The general flow of CALIB is shown in Figures 2 and 3. The main program waits for command from the terminal and dispatches control to appropriate subroutines which execute the desired function. Data is acquired in parallel by servicing the CAMAC LAMs which have been enabled. The AST routine ANALYZER is called to execute CAMAC operations every event and to perform rudimentary analysis such as filling histograms. Any additional online processing should be added to this routine. CAMAC operations are performed using the Kinetic System Corporation 6610-1B Software Support Package. This package is provided under the current version of VMS and consists of a loadable VMS CAMAC driver and a set of FORTRAN callable interface routines.

3.2 Histograms, Access to CAMAC and Analysis

In general one must modify the subroutines CALIB.PLOT.INIT, and ANALYZER to define additional histograms or to address new CAMAC modules. Histograms are defined at initialization time and filled in the interrupt routine ANALYZER using standard HBOOK calls. At present ANALYZER performs rudimentary analysis in addition to filling histograms, but its capability may be enhanced as appropriate. CAMAC modules are addressed using FORTRAN callable subroutines which are described in detail in Appendix C. For example, to read 10 channels from slot 5 at crate 0 using a block transfer DMA (QSCN mode) use the following call:

```
call cab16(chan,0,5,0,read_code,qscn,buffer,10,status)
```

The crate and LAM number are specified in the data input file CAL.INIT.DAT.
Figure 2: Flowchart of Main Program.
Figure 3: Flowchart of interrupt routine ANALYZER.
A  CALIB commands

• BROWSE

Fast display of all the histograms. Display begins from the histogram's identification number typed in, otherwise from the smallest histogram's identification number. After each display the system will ask the user whether or not he wishes to continue. If not, type 'N' or 'n', otherwise simply type the <CR> key.

Format :
BROWSE [histogram-identification-number]

Parameters :
Histogram's identification number. Default is the smallest number.

Qualifier :
None

• DEBUG

Enable/Disable DEBUG mode, with Enable( ON ) mode, data being read through CAMAC interface will be displayed on the screen, including both TDC and ADC data.

Format :
DEBUG mode

Parameter :
ON - enable debug mode
OFF - disable debug mode

Qualifier :
None

• ERASE

Clear the graphics ,text, or both on the screen according to the parameter the user typed it in.
Format:
   * ERASE parameter

Parameter:
   * Graphics – Clear the graphics on the screen
   * Text – Clear the text on the screen
   * Both – Clear both graphics and text on the screen (Default)

Qualifier:
   * None

- **EXIT**

   Exit from CALIB or type CTRL/Z to exit

   format:
      * EXIT

   Parameter:
      * None

   Qualifier:
      * None

- **HARDCOPY**

   Send metafile to a specific laser printer. The metafile is opened using the command META and plots are made using PLOT.

   Format:
      * HARDCOPY[/qualifier] parameter

   Parameter:
      * Laser printer device name. The default is CB113.

   Qualifier:
      * /(NO)DELETE
        * Whether or not to delete metafile after printing. The default is DELETE.
• HELP

    List all defined commands.

    Format :
    HELP
    Parameter :
    None
    Qualifier :
    None

• HISTS

    List of all defined histograms

    Format :
    HISTS
    Parameter :
    None
    Qualifiers :
    None

• META

    Open the metafile to be printed. All subsequent PLOT commands will result in plots displayed on the screen and saved in the metafile.

    Format :
    META parameter
    Parameter :
    File name to be used for metafile. The default name is CALIB.META.
    Qualifier :
    None

• PLOT
This command will display one- or two-dimensional histograms on the screen with various options specified by the command qualifiers.

Format:
   PLOT[/qualifiers] Histogram_number

Parameter:
   Histogram number "ID"

Qualifiers:
   /SCATTER
   Plot histogram in scatter mode. SCATTER is a default mode for two dimensional histogram
   /LEGO
   Plot histogram in lego mode for two dimensional histogram
   /CONTOUR
   Plot histogram in contour mode for two dimensional histogram
   /SURFACE
   Plot histogram in surface mode for two dimensional histogram
   /LOG
   If this qualifier is set, the scale for the Y axis is logarithmic, otherwise it is linear
   /STATISTICS
   Set this qualifier to output plot statistics.

• RESET

   Zero histograms and counters.

Format:
   RESET

Parameter:
   None

Qualifier:
   None

• RUN
Enable interrupts (Look - At - Me)

Format :
RUN
Parameter :
None
Qualifier :
None

• STOP

Disable interrupts (Look - At - Me)

Format :
STOP
Parameter :
None
Qualifier :
None

• STATS

List run parameters

Format :
STATS
Parameter :
None
Qualifier :
None
B  VAX/VMS Command Definition Utility

The VAX/VMS operating system has a software tool called Command Definition Utility[6] which may be used to develop command-driven software. The Command Definition Utility may be used to define terminal commands with the same syntax as the Digital Command Language (DCL). The VAX/VMS Command Language Interpreter (CLI) may then be used to parse the user defined commands.

The VAX/VMS CLI routines are used to process command strings using information from a command table. The command table defines parameters and qualifiers for each command. To create or modify a command table, you must write a command definition file and then process this file with the Command Definition Utility, see the VAX/VMS Command Definition Utility Reference Manual. The CLI routines include:

- CLI$DCLPARSE
- CLI$DISPATCH
- CLI$GET_VALUE
- CLI$PRESENT

When you use the Command Definition Utility to add a new command to your process command table or to the DCL command table, use the CLI$PRESENT and CLI$GET_VALUE routines in the program that is invoked by the new command. These routines retrieve information about the command string that invoked the program.

When you use the Command Definition Utility to create an object module containing a command table, and you link this module with a program, you must use all four CLI routines. First, use CLI$DCLPARSE and CLI$DISPATCH to parse command strings and invoke routines. Then, use CLI$PRESENT and CLI$GET_VALUE within the routines that execute each command.

The Command Definition Utility is very sophisticated, but easy to use. We give an example to explain how to build our own program using the Command Definition Utility to help understanding the command input to CALIB.
B.1 Build your own command definition file

Use the text editor to create a command definition file named EXAMPLE.CLD, which defines two commands, EXAMPLE and EXIT. The routine process_example processes the command EXAMPLE and the routine process_exit is executed when the EXIT command is issued. The command EXAMPLE requires that a parameter be entered after the command name. If it is omitted, the CLI service will issue the "File name:" prompt. Qualifiers to the command line are entered after a backslash ("/"). In the present example the qualifier label is "p2" which can be checked by the command processing routine (see process_example below). The EXIT command has no parameters or qualifiers.

    module command_table
    define verb example
    parameter p1,label=file,value(required),prompt="File name"
    qualifier,edit,label=p2
    routine process_example
    define verb exit
    routine process_exit

B.2 Example

We give an example which will process commands defined by the command definition file above.

    program my_program
    c
    integer*4 cli$dcl_parse,cli$dispatch,lib$get_input
    integer*4 process_example,process_exit
    character*80 a
    external command_table
    c
    c Issue a read to the terminal and wait
    c
    10 call lib$get_input(a,'MYSOFTWARE')
    if(.not.cli$dcl_pares(a,command_table)) goto 10
    c
terminal input: process command

call cli$dispatch
goto 10
end

integer function process_example

Process command EXAMPLE

integer*4 cli$present,cli$get_value
character*80 a

Check for qualifier "p2"
If present, type parameter

if(.not.cli$present('p2'))goto 30
call cli$get_value('p2',a)
type 10,a
10 format(4x,'Qualifier is present: ',a)

c Get (required) parameter file and type out

call cli$get_value('file',a)
type 20,a
20 format(4x,'File name is ',a)
return
end

integer function process_exit

c Dummy command to exit program

call exit
end
C The Kinetic System Corporation 6610-1B Software Support Package

The Kinetic System Corporation 6610-1B Software Support Package is provided under the current version of VMS and consists of a loadable VMS CAMAC driver and a set of FORTRAN callable interface routines. The FORTRAN routines supplied by KSC can be used in conjunction with VMS FORTRAN. These routines may also be used with any language that supports the VMS calling sequence. The standard FORTRAN routines provide a simple direct set of calls to perform I/O operations to CAMAC. The calls are divided into six groups:

- Initialization
  - CAOPEN(chan,device,StatusArray)
  - CACLOS(chan,StatusArray)

- Single-Action Data Transfer
  - CAM16(chan,C,N,A,F,data,StatusArray)
  - CAM24(chan,C,N,A,F,data,StatusArray)

- Block Transfer
  - CAB16(chan,C,N,A,F,mode,DataArray,TransCount,StatusArray)
  - CAB24(chan,C,N,A,F,mode,DataArray,TransCount,StatusArray)

- Status and Control
  - CACTRL(chan,C,func,StatusArray)
  - CCSTAT(chan,C,CrateStat,StatusArray)
  - CAMSG(StatusArray)

- LAM or Asynchronous Action
  - CALAM(chan,C,LAMid,Type,Prio,ASTadr,ASTpar,ClrN, ClrA,ClrF,DsaN,DsaA,DsaF,StatusArray)
The CAMAC interface routines are called either as a subroutine:

    CALL camroutine(arguments...),

or as an INTEGER*4 function subroutine:

    INTEGER*4 camroutine,IERROR

    .

    IERROR=camroutine(arguments...)

where camroutine is one of the CAMAC routines. In the case of the subroutine calls, the error condition is returned in the variable StatusArray and follows the usual VMS convention. A "1" is returned if the operation was successful.
D Installation of the CAMAC driver

The 6610-1B software package contains the following files which are distributed by Kinetic Systems Corporation.

<table>
<thead>
<tr>
<th>File</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CADRIVER.OBJ</td>
<td>The 2922 CAMAC device driver.</td>
</tr>
<tr>
<td>CABUILD.COM</td>
<td>Command file to build the driver.</td>
</tr>
<tr>
<td>CALOAD.COM</td>
<td>Command file to load the driver.</td>
</tr>
<tr>
<td>CAUSER.INC</td>
<td>An include file defining fortran parameters.</td>
</tr>
<tr>
<td>CAMAC.OLB</td>
<td>The fortran CAMAC library.</td>
</tr>
<tr>
<td>CAMSHR.EXE</td>
<td>Sharable image library.</td>
</tr>
<tr>
<td>CAMERR.MSG</td>
<td>Error message file.</td>
</tr>
<tr>
<td>66101B.TXT</td>
<td>Driver definition file.</td>
</tr>
<tr>
<td>CAMAC.CLD</td>
<td>DCL verb definition file.</td>
</tr>
<tr>
<td>CAM.EXE</td>
<td>CAMAC/DCL interface file.</td>
</tr>
<tr>
<td>CACTRL.EXE</td>
<td>CAMAC/DCL interface file.</td>
</tr>
<tr>
<td>CCSTAT.EXE</td>
<td>CAMAC/DCL interface file.</td>
</tr>
</tbody>
</table>

We give a list of steps (D.1 – D.9) which should be followed in order to install the Kinetic Systems CAMAC Driver.

D.1 Restoring software distribution kit

example commands:
CREATE/DIRECTORY device:[uic]
MOUNT/FOREIGN tape..device..name:( MUA0:)
BACKUP/REW/LOG MUA0:[*...] device:[uic]
DISMOUNT MUA0:

D.2 Making a back-up copy of the software be created

example commands:
MOUNT/FOR MUA0:
BACKUP/REWIND/LOG device:[uic] MUA0:2922.BAC
DISMOUNT MUA0:
D.3 Changing VMS sysgen parameters

In order for the Kinetic Systems Software package to operate correctly a few SYSGEN parameters must be set on the system as shown below:

```plaintext
SET DEFAULT SYS$SYSTEM
RUN SYSGEN
SYSGEN>USE CURRENT
SYSGEN>SET REALTIME SPTS 1024
SYSGEN>WRITE CURRENT
SYSGEN>EXIT
```

D.4 Rebooting system by executing SHUTDOWN.COM

D.5 Linking the driver

To link the Driver execute the following command procedure

```plaintext
@CABUILD.COM ( linking the driver)
( $link/notrace/exe=sys$system:cadriver cadriver )
```

D.6 Checking the connect command in CALOAD.COM

- Before inserting CALOAD.COM into SYSTARTUP.COM, set the switches for the Control and Status Register (CSR) and the interrupt VECTOR address on the 2922 Q-bus CAMAC interface to match the software settings. Care must be taken so that the interface does not conflict with other device settings. We use the factory default settings of

  ```plaintext
  CSR = 763740
  Vector = 760
  Adapter= UB0
  ```

- Checking configuration using the command SHOW/CONFIG with SYSGEN.

- The following switch settings set the CSR and Vector addresses given above
D.7 Checking other commands in CALOAD.COM

Installing CAMAC supporting routines into library and, CAMAC interactive commands into DCL table.

D.8 Changing startup command procedure

Putting changed CALOAD.COM into SYS$MANAGER:SYSTARTUP.COM.

D.9 Rebooting system.
References


