# Technical Information Manual

Revision n.8

3 December 2008

**MOD. C111 C**

*ETHERNET CAMAC*
*CRATE CONTROLLER*
**MANUAL REV. 8**

**NPO:**
**00108/04:C111C.MUTx/08**

CAEN will repair or replace any product within the guarantee period if the Guarantor declares that the product is defective due to workmanship or materials and has not been caused by mishandling, negligence on behalf of the User, accident or any abnormal conditions or operations.

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*CAEN reserves the right to change partially or entirely the contents of this Manual at any time and without giving any notice.*

## Disposal of the Product

*The product must never be dumped in the Municipal Waste. Please check your local regulations for disposal of electronics products.*

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# 1. General description

## 1.1. Overview

The CAEN Mod. C111C is a complete CAMAC controller that allows advanced interaction by means of standard Ethernet services, such as a local web server and TCP socket based communication protocol. The present document supports modules running **Firmware Rev. 2.07 and later**. The basic hardware architecture of C111 C is illustrated below.

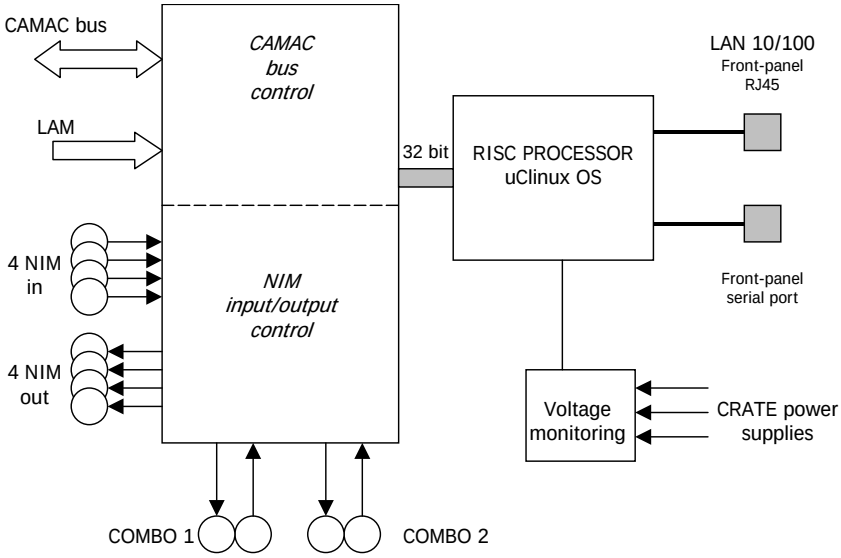



**Fig. 1.1: Mod. C111C block diagram**

A local processor runs a version of Linux optimized for low memory footprint; a CAMAC bus control subsection handles all bus access operations and interactions, and a separate NIM subsection manages I/O signals located on the front panel.

**Table 1.1: Summary of features**

| | |
|---|---|
| CAMAC bus access | Full CAMAC bus control, including LAM detection<br>Plugs into slots 24 and 25 |
| Local NIM I/O Section | 4 outputs, 4 inputs, event counters, 2 COMBO I/O (trigger/busy) modules<br>programmable pulse generators<br>input event counters<br>NIM default settings can be reloaded with front panel button |
| Remote Control Library | ANSI C remote control library derived from the ESONE standard, with extensions to control local resources<br>Remote control of all functions through TCP socket |
| Local Web Server | Dynamic local web server allows advanced monitoring and control without the need to install dedicated software (perfect for crate setup and maintenance)<br>User page with results from script |
| Advanced Scripting Engine | Embedded script interpreter allows local execution of C-like code, with full control on CAMAC and NIM functions<br>No need to install cross-compilation toolchains |
| Front Panel Indicators | X and Q signals on last access<br>4 user LEDs (controllable from script)<br>Fault, connection status and NIM default indicators |

# 2. Starting up

- Please insert the controller **into slots 24 and 25 ONLY** of a standard CAMAC crate (rightmost when looking the crate from the front side)
- if default network settings are compatible with your setup, connect a LAN cable to the front-panel RJ45 socket
- Power up the CAMAC crate
- Wait about 20 seconds to allow completion of operating system boot (It might require a longer time, depending on your network configuration, especially DHCP).
- If default network settings are not suitable for your network environment, connect a terminal to the front panel serial port and make the necessary variations (see **Serial port control** section). After that, reboot (either by cycling the main power or by pressing the RESET front panel button) and wait about 20 seconds.
- Note: if you connect directly an PC with the module (i.e., a point-to-point connection) you MUST use a cross cable; this is a typical requirement for LAN devices.

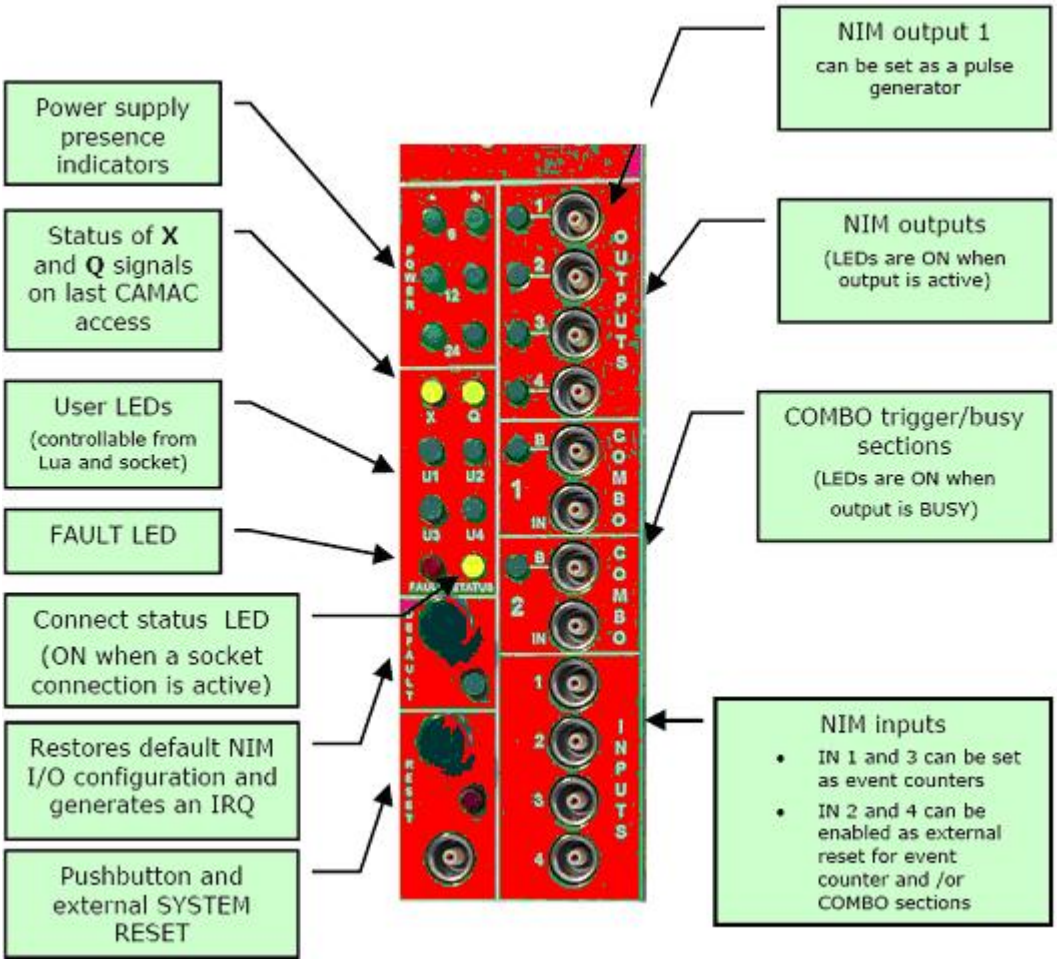



**Fig. 2.1: Front Panel description**

Please open your browser (on a host connected to the same LAN used by C111C) and point to its IP address; the default IP address is 192.168.0.98. From the web server pages, you already have control over the NIM I/O section and the possibility to perform individual commands on the CAMAC bus.

## 2.1. Front Panel


**Fig. 2.2: Mod. C111C Front Panel**

# 3. Serial port control

A serial port connector located on the front panel allows the user to modify system settings; this procedure is required if current network parameters are incompatible with the local network. It is also possible to modify startup options.
Default connection parameters are the following: 38400 baud, 8-N-1, no flow control. Please notice that the baud rate can be modified by a dedicated command. Echo is not enabled on the serial port, so please enable character echo on your serial terminal.
The following commands are available:

**Table 3.1: Serial port available commands**

| | |
|---|---|
| help | Provides a quick list of commands on terminal |
| setip <new IP addr> | sets a new IP address, to be written in the format *aaa.bbb.ccc.ddd* |
| setmask <new mask> | sets a new IP mask |
| setgw <new gw addr> | sets a new gateway IP address |
| setdhcp <0\|1> | if set to 1, enables the local DHCP client |
| getip<br>getmask<br>getgw<br>getdhcp<br>getmac | Allows retrieval of current network settings and of the internal MAC address |
| setrob <0\|1> | if set to 1, enables the Lua Run-On-Boot option |
| setcscan <0\|1> | if set to 1, enables the Crate Scan function (executed at startup only) |
| getrob<br>getcscan | Allows retrieval of current startup settings (Lua Run-On-Boot and Crate Scan) |
| getserial | Allows retrieval of current board serial number |
| getcspeed<br>setcspeed <baudarate> | Sets/gets current COM speed<br><br>Allowed speeds: 50, 75, 110, 134, 150, 200, 300, 600, 1200, 1800, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400; if the baudrate value is not allowed, speed defaults to 38400 baud. |
| getname<br>setname <name string> | Sets/gets current name displayed on the web server index page<br><br>(string name can be up to 16 characters) |
| listuser<br>adduser <username:pwd><br>deluser <username:pwd> | Manage current authorized web users list<br><br>(username and pwd are ascii string of any length) |

| | |
|---|---|
| *Note:* | *The front-panel connector requires a straight serial cable (pin 2 to pin 2, pin 3 to pin 3); only RX, TX and GND are required.* |

The new firmware release (2.05 or greater) provides an additional feature that, when enabled, takes control over the serial port and allocates a TCP socket to serial converter. A TCP socket server is activated on port 2003; any terminal-like application can connect as a TCP client and interact remotely with the serial port. To enable the TCP socket server (see § 4.2). To modify serial port settings when in TCP server mode, see within the System Parameters (see § 9). Please notice that when the TCP server is enabled, the above protocol is not implemented. Therefore TCP communication allows to write/read commands through the C111C Serial Port. This feature is extremely useful if a serial-controlled device is located near the crate, i.e., a serial LCD display, a remote data acquisition or I/O expander, a local PLC.

# 4. Startup options

C111C startup options can be tuned in order to provide a fine control over performance and connectivity. There are some settings stored in nonvolatile memory that can be changed with the control socket or from the serial port, and some options that require placement or removal of jumpers inside the unit.

## 4.1. Startup flags

Two flags are available for startup fine-tuning:
Lua script Run-On-Boot flag
Crate Scan Enable flag
Both are stored in the local EEPROM and can be modified with dedicated commands on the serial port (**getrob**, **setrob**, **getcscan**, **setcscan**) or from the control socket.
The **Lua Run-On-Boot** flag, when enabled, tells the system to run the stored Lua script after starting up the application; its main usage is for automated crate initialization and for unattended control.
**Crate Scan** is a function available on C111C to allow automatic detection of cards inserted into the crate. It is a quick way of verifying the presence of cards that may be required by the acquisition code (either within the Lua script or on the host application).
Being a heuristic approach to card detection (there is no formal way of detecting a card when inserted into the crate) the Crate Scan function may interfere with specific CAMAC cards; it is thus possible to disable the Crate Scan function. Note that Crate Scan is executed only at startup (in order to avoid possible interaction with ongoing script or actions from host); if the feature is disabled, it will not be possible even from socket.

A description in pseudo-code of the Crate Scan function follows:

```
for (slot=1; slot < 23; slot++)     {
  end_slot = 0
  for (fun=0; fun < sizeof(SCAN_FUNCTION); fun ++)
    for (addr = 0; addr < 32; addr ++)   {
      X = CSSA (slot, SCAN_FUNCTION[fun],addr, 0)
      if (X == 1)  {
            slot_status[slot] = 1
            end_slot = 1
            }
      }
  if (!end_slot)  slot_status[slot] = 0
  }
```

*where SCAN_FUNCTION is the following array:*
0, 1, 2, 3, 8, 9, 10, 11, 24, 25, 26, 27, 16, 17, 18, 19

## 4.2. Jumper settings

It is possible to force some startup options by placing or removing internal jumpers.
Only experienced personnel should perform this operation.
The operation is described in steps, as follows:
- switch off power from the crate
- remove the controller from the crate
- remove the lateral cover (left side when looking on the front panel) of the controller; you should see the internal boards with components facing your side

- locate the jumper block, right behind the serial port connector
- note that if all jumpers are removed (default condition), then the unit will perform in the standard mode; insert jumpers only if you want to modify the standard setup, according to the table:

**Table 4.1: Available jumpers**

| Insert jumper on | to disable | Notes |
|---|---|---|
| **JMP10** | TELNET | Disable telnet to avoid system access to local resources; used only for performing a firmware upgrade or for debug. |
| **JMP9** | WEB SERVER | Disable web server if HTTP access not required in order to obtain maximum performance; note that it cannot run if application is also disabled |
| **JMP8** | APPLICATION | Disable application if the system hangs after powerup (i.e., after failing a firmware upgrade) |
| **JMP7** | COM SERVER | Disable serial port application if the system keeps hanging after powerup; it may also be used to prevent local access to critical parameters (i.e., network settings) |

Please notice that, on C111C, TELNET is an insecure method to control the unit; no password and no encryption are provided. Therefore, if the application requires it, it may be safer to disable telnet access.

# 5. Remote control

The unit has been designed to allow full control from a remote location, taking advantage of the available high-speed Ethernet interface.
A summary of the implemented TCP/IP services is detailed.

**Table 5.1: Remote control available commands**

| Service | Port | Notes |
|---|---|---|
| HTTP server | 80 | Dynamic Web Server; it serves up to 5 client browsers at the same time. |
| TCP server | 2000 | TCP control socket for ASCII commands; up to 2 different clients are allowed at the same time (see **TCP ASCII control socket** section). |
| TCP server | 2001 | TCP control socket for binary commands only (see **TCP binary control socket** section). |
| TCP server | 2002 | TCP socket server for interrupt management (see **Interrupt handling** section). |
| TCP server | 2003 | TCP socket server for socket to serial link (see **Jumper settings** section) |
| Telnet server | 23 | System telnet server; it is used mainly for firmware updates and may be disabled by the user (see **Startup options** section).<br>Please note that the telnet connection is unsafe (no password-protected access, no encryption). |

The **local web server** allows an easy and quick access to CAMAC commands, test and monitoring functions. Simple CAMAC operations can be easily performed by means of a user-friendly web interface, with no need of programming or learning manuals. This very useful especially when performing quick lab tests on CAMAC modules. See section **Local Web Server** for details.
The **socket connection** is the main control method for general applications: the host computer opens a TCP connection to the C111C IP address at port 2000 and then starts sending commands. A command is a simple ASCII string. Command can be sent by host computers through a specific DAQ application, or manually, using a terminal program like **telnet** (for Unix/Linux) or **HyperTerminal** (for Windows). For example, a socket connection can be manually opened from a Linux host by typing: *telnet <jenet IP addr> 2000*. As soon as the connection is established, C111C is ready to accept commands from the host keyboard. See section **TCP ASCII control socket** for details, and section **ASCII commands reference** for a complete list of the ASCII commands.

The command set of C111C is composed of simple ASCII strings. Moreover, a command subset is also available in "**binary format**" to improve speed performances. Port 2001 is dedicated to this function. See section **TCP binary control socket** for details.

A **telnet server** is also available on port 23. Typing *telnet <jenet IP addr>* the user can access the C111C internal filesystem. It is recommended for expert users only.

C111C can also notify the host computer that some asynchronous external events (LAM, COMBO trigger and DEFAULT button pressure) have occurred. The TCP port 2002 is dedicated to this function. See section **Interrupt handling** for details.

The internal software architecture is designed to allow control of multiple crates. It must be considered that, when using an Ethernet-based CAMAC controller, the distinction between crates is implicit as every crate is identified by a different IP address. Therefore the crate number is typically not a parameter in many command definitions.

## 5.1. TCP ASCII control socket

Remote control is organized as follows:
the local firmware opens a TCP socket server on port 2000 and waits for connection from a remote client;
when a client connection is detected, front panel LED status lights up; it will remain on until there are active connection to the socket server;
the server accepts ASCII commands from the remote client (see section **Commands Reference**); return string is always in the following format:

**Table 5.2: control socket format**

| | |
|---|---|
| **-1** | Command exists, but parameter format or number is wrong |
| **-2** | Command does not exist |
| **0 <return value>** | Command returns correctly the return value (it may also be null) |

note that more than one remote client can connect to the socket server; it is up to the programmer to avoid conflicts when accessing the same resources, as there is no built-in protection for access conflicts (in other words: stick to one remote client only unless you really know what your are doing). Multi-client usage is useful especially during development and debug.
The socket server NEVER generates data autonomously; in the special case when C111C needs to communicate to the host that a specific event has occurred (analogously to an interrupt request), it works through a separate communication channel (IRQ port 2002).

A complete reference of ASCII commands is available in section 10.

| | |
|---|---|
| *Note:* | *On Windows 2000/XP, it is possible to perform a quick test with the Hyperterminal application, by specifying connection with TCP/IP and port 2000; on linux hosts, you can use the standard telnet client in "raw" mode , by typing*<br>`telnet <Jenet IP address> 2000` |

## 5.2. TCP binary control socket

A "binary command subset" is also available to increase speed and data transfer rate. A TCP server for binary commands is available on port 2001: binary commands must be sent through that port only.
A dedicated C/C++ library has been written to use these commands in a straightforward and transparent way, with no need to know all the implementation details described here.
**Users writing their host DAQ applications in C or C++, can skip this chapter.**
See section **C library** for details.
In general, the binary command has the following format:

byte(0) = STX;
byte(1) = CMD_CODE;
byte(2) = databyte(0)
byte(3) = databyte(1)
....
byte(n) = databyte(k)
byte(n+1) = REQ_RESPONSE;
byte(n+2) = ETX;
where:

STX is the hexdecimal value 0x02
ETX is the hexdecimal value 0x04
CMD_CODE may be one of the followings value:
BIN_CFSA_CMD = 0x20 (equivalent to the ascii command cfsa)
BIN_CSSA_CMD = 0x21 (equivalent to the ascii command cssa)
BIN_CCCZ_CMD = 0x22 (equivalent to the ascii command cccc)
BIN_CCCC_CMD = 0x23 (equivalent to the ascii command ccci)
BIN_CCCI_CMD = 0x24 (equivalent to the ascii command ctci)
BIN_CTCI_CMD = 0x25 (equivalent to the ascii command ctci)
BIN_CTLM_CMD = 0x26 (equivalent to the ascii command ctlm)
BIN_CCLWT_CMD = 0x27 (equivalent to the ascii command cclwt)
BIN_LACK_CMD = 0x28 (equivalent to the ascii command lack)
BIN_CTSTAT_CMD = 0x29 (equivalent to the ascii command ctstat)
BIN_CLMR_CMD = 0x2A (equivalent to the ascii command clmr)
BIN_CSCAN_CMD = 0x2B (equivalent to the ascii command cscan)
BIN_NIM_SETOUTS_CMD = 0x30 (equivalent to the ascii command nim_setouts)
databyte(0) ..databyte(k) is of variable length according to the command code
REQ_RESPONSE may be:
NO_BIN_RESPONSE = 0xa0 (no response requested)
Any other value (response requested)

If one of the databyte(0)..databyte(k) contains 0x2, 0x4 e 0x10, then the databyte must be converted in two bytes accordingly to the following rule:
if databyte(n) = 0x2 => converted in => databyte(n) = 0x10; databyte(n+1) = 0x80 + 0x02;
if databyte(n) = 0x4 => converted in => databyte(n) = 0x10; databyte(n+1) = 0x80 + 0x04;
if databyte(n) = 0x10 => converted in => databyte(n) = 0x10; databyte(n+1) = 0x80 + 0x10;

A complete reference of binary commands is available in section 12.

## 5.3. Interrupt handling

On C111C, specific events can generate an interrupt (IRQ) that is notified to the host. Being socket-based, the connection method is rather different from a bus-based connection; therefore, interrupt are handled in a message-based way.

There are three possible IRQ sources:
LAM requests
COMBO Triggers (see **COMBO I/O** chapter)
DEFAULT pushbutton pressure

When an IRQ event is generated, C111C sends a special string to the host computer through the dedicated TCP server at port 2002. The string format is a upper case letter followed by a 32-bit hex value in ascii:
LAM events: **"L_<00hhhhhh>"**, where <hhhhhh> is the ASCII representation of the LAM register content in hex (24-bit).
COMBO events: **"C <bitmask> ",** where:
bit0 = combo1 interrupt pending
bit1 = combo2 interrupt pending
bit2 = dtc combo1 interrupt pending
bit3 = dtc combo2 interrupt pending
bit4-31 = ignored

DEFAULT pushbutton pressure: **"D defadefa"**

On the host, an IRQ dedicated client receives the messages and launches the proper IRQ-service program. For example, if a LAM or COMBO generated IRQ is received, the host can start a reading sequence of some modules.
The IRQ generated by a DEFAULT pushbutton pressure is a very powerful feature that allows the user to start different programs at each pressure of the button: for example, different module setups can be activated when the button is pressed and different actions can be performed.
Please refer to the C library documentation for further details.
In the following diagram, a typical scenario with 2 separate crates is shown.

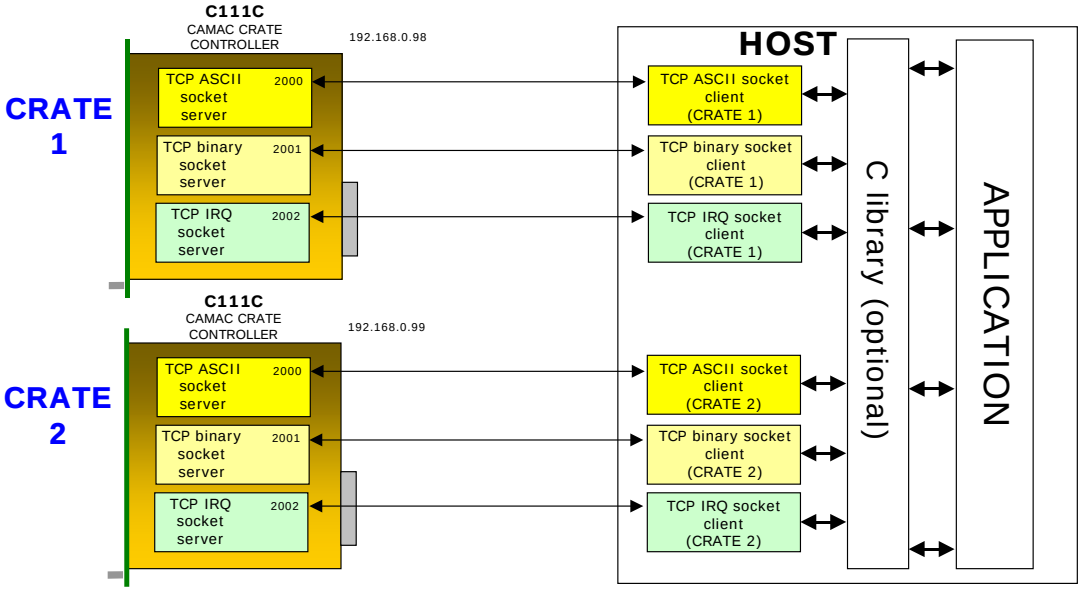



**Fig. 5.1: Remote control with 3 separate crates**

## 5.4. Block transfers

The C111C TCP protocol has been expanded with block transfer commands. Care has been put in optimizing performance; while the whole protocol on TCP has been designed to be as simple and intuitive as possible, block transfer commands are not following this approach.
The following block transfer modes are implemented:
Address Scan mode
Repeat mode
Stop mode
Following the IEEE standard, the Q line assumes different meanings depending on the selected type of block transfer:

**Table 5.3: Q line meaning**

| Reply | Address Scan mode | Repeat mode | Stop mode |
|---|---|---|---|
| Q = 1 | Register is present | Register is ready | Continue block transfer |
| Q = 0 | Register is missing | Register is not ready | End block transfer |

Some remarks follow on our solution to block transfer.

- Block data is transferred on the same TCP socket connection used for commands.
- During a block transfer, no other commands can be sent over the socket connection; therefore, block transfer must be completed before other commands can be sent. The user must take care of this limit, as any command can cause a block transfer abort.
- If multiple clients connect to the same TCP control socket server on C111C, they might violate the condition detailed above. As already mentioned on the User's Manual, don't use multiple clients unless you are debugging or you really know what you're doing.
- To allow transfer of large block data in read operations, local buffering is implemented. Read data are transferred to the host in buffers, every time the local buffer is filled. Buffer size is programmable to adapt different requirements and calibrate the tradeoff between optimal transfer efficiency and response time.
- Read operations are available in ASCII and binary mode. ASCII mode is perfect for quick debugging and verification, while binary mode offers higher performance at the cost of increased protocol complexity (being a mixed ASCII-binary protocol).
- Write operations are only available in in ASCII mode.
- Write operations are consumed in streaming mode: C111C does not wait for the whole block data set to begin writing.

A brief summary of available commands follows:

**Table 5.4: Block transfer available commands**

| | | |
|---|---|---|
| Utility | BLKBUFFS | Block transfer buffer size set |
| | BLKBUFFG | Block transfer buffer size get |
| Q-stop | BLKSS | Block transfer, 16-bit, Q-stop mode |
| | BLKFS | Block transfer, 24-bit, Q-stop mode |
| Q-repeat | BLKSR | Block transfer, 16-bit, Q-stop mode |
| | BLKFR | Block transfer, 24-bit, Q-repeat mode |
| Address Scan | BLKSA | Block transfer, 16-bit, address scan mode |
| | BLKFA | Block transfer, 24-bit, address scan mode |
| In general the command is expressed as **BLKsm**<br>where s = S (short), F(full)<br>m = S (Q-stop), R (Q-repeat), A (address scan)<br>Read or write mode is determined by the Function code passed as a parameter, as follows:<br>F = 0,……,7 ➔ READ mode<br>F = 16,…,27 ➔ WRITE mode | | |

All block transfer commands have the same behavior. C111C replies to the command itself immediately after reception, before executing the actual block transfer, with one of the following possible replies (compliant with the standard command response of the TCP control socket protocol):

**Table 5.5: Block transfer possible replies**

| Reply | |
|---|---|
| 0 | OK, operation in progress |
| -1 | error, wrong parameters |
| -2 | error, non existing command |

The general format of a data block is

**hdr data1 data2 ….. dataK**

where:
**K** is the current buffer size
in ASCII mode, hdr is formatted as %03X
in ASCII mode, dataj is formatted as %06X (for both 16-bit and 24-bit access types)
in ASCII mode, the data block is terminated by a "\r" character
in binary mode, hdr and dataj are all 32-bit values

in binary mode, the data block is (K+1)*4 bytes
if there are non significant data values (if cmd < K, or cmd = 0), data block size is always the same as above

**hdr** is a header that can assume one of the following values:

**Table 5.6: Cmd values**

| hdr | | notes |
|---|---|---|
| 0 | End of block transfer | data1= actual datasize<br>data2,…dataK = non significant |
| N > 0 | Number of data words being transferred | If N<K, then dataN,dataN+1,…..,dataK are non significant |
| -3 | Timeout error | data1= actual datasize<br>data2,…dataK = non significant |
| -4 | Abort error | data1= actual datasize<br>data2,…dataK = non significant |

A complete reference of block transfer commands is available in §10.

## 5.5. C library

Although the host programs can be written in any language, a C library is available to simplify code generation: host clients, IRQ handling and binary commands can be handled in a very easy and transparent way that releases the programmer from taking care of low-level details.
The **C library** is an ANSI C library, delivered in source form, providing an ESONE-like abstraction to the socket protocol, including multiple crate support. Documentation specific to the C library is on a separate document available on the C111C support web site.
The C library is compatible with C++ compilers like g++.
Please note that the C library on host is provided “as is”, in source code form, without any form of warranty of support. You are allowed to modify it freely, but under any circumstance you are responsible for its use (o misuse).

## 5.6. Remote Reset

An hardware reset can be given either by pressing the “RESET” pushbutton on the front panel or, by remote, closing an external switch connected to the “RESET” input on the front panel.
A remote reset can also be sent from the network:From a socket connection on port 2000: send the command “reset”. If working from a terminal window, just type “reset”.
6.From a telnet connection (port 23): type “reboot”.

## 5.7. Local web server

The local web server is a dynamic server, in the sense that gathers relevant data and information directly from the machine; therefore, depending on page contents, page refresh may be slower than expected if compared to a fully static web site.
A username and a password are required to access the local web server. Default values are "*jenet*", "*jenet*". Other usernames and passwords can be added, modified or deleted by means of the commands *"user_add", user_del", user_list"*. See the **Command reference** section for details.

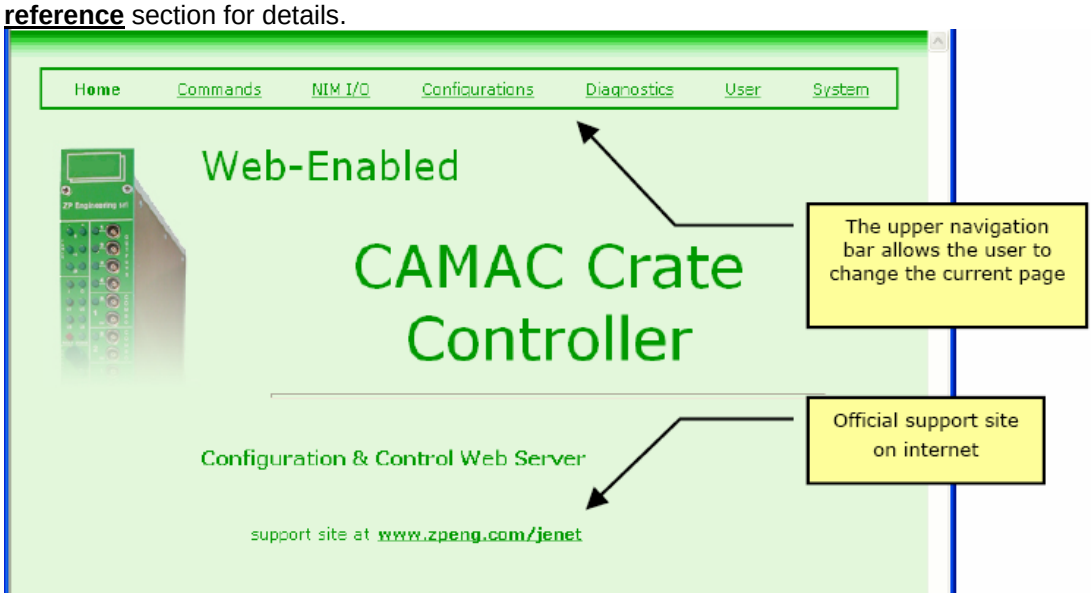
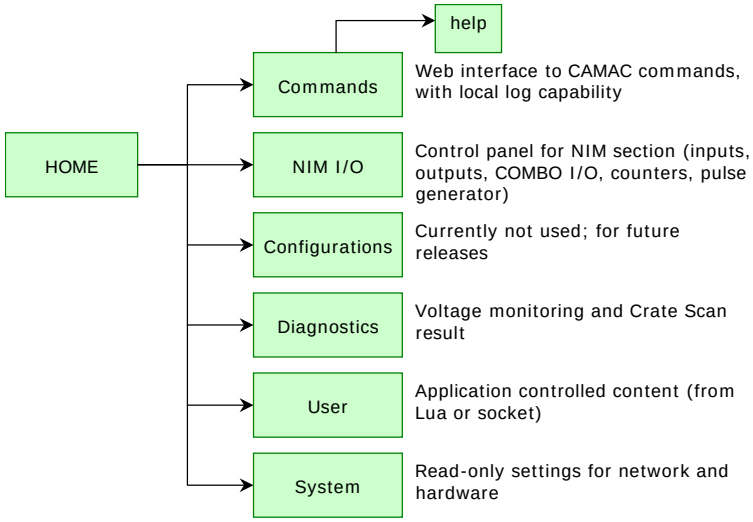



**Fig. 5.1: Web server page**

**Note:** in order to trigger update operations in the optimal way, it is best to click on the link available on the navigation bar, instead of hitting the refresh button of the browser (i.e., F5 on Internet Explorer). This is due to the difference in HTTP requests that are sent by various web browsers when refreshing the page.



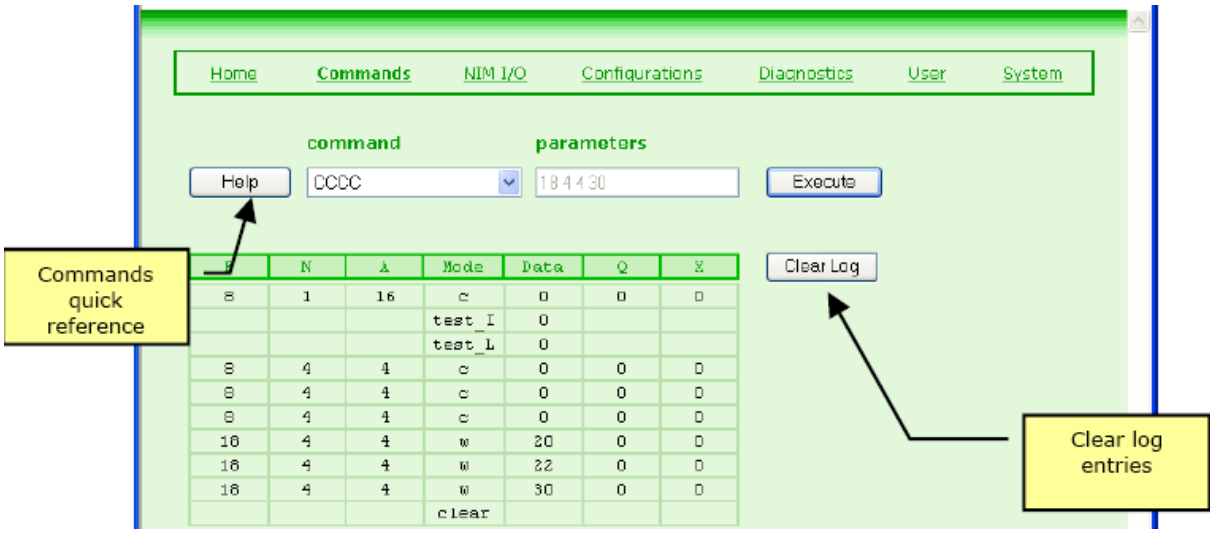

**6.1.Fig. 5.2: Web server structure**

## 5.8. Commands page

The local web server contains a page dedicated to CAMAC commands, in order to allow immediate testing of crate functions. There is a log capability, currently limited to actions performed on the web page. A drop-down selection box allows the choice of one of 7 CAMAC commands; on the entry box the relevant parameters have to be entered; when pressing the EXECUTE button, the commands will be executed. For read functions, the result is available on the data field of the log section; for testing functions, the result is available in the data section, with values 0 or 1.
Please remember that in the current implementation logging is enabled only for commands executed from this web page. Logging is ten events deep; it is also possible to clear the log directly on the web page.

**Table 5.1: Commands table**

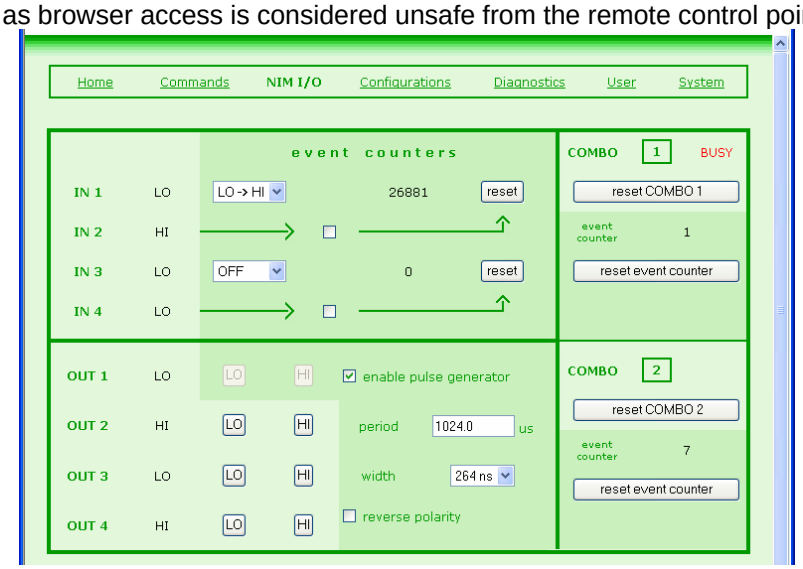
| Syntax definition | Description | Notes |
|---|---|---|
| **CSSA** <function> <slot> <subaddr> <data> | execute a CAMAC command with 16-bit data | response in Q<br>function=0..31,<br>slot=1…23<br>subaddr=0…15 |
| **CFSA** <function> <slot> <subaddr> <data> | execute a CAMAC command with 24-bit data | response in Q<br>function=0..31, slot=1...23<br>subaddr=0...15 |
| **CCCC** | generate dataway initialize | |
| **CCCZ** | generate crate clear | |
| **CCCI** <value> | set/clear dataway inhibit + Z cycle | value=0 (reset), value=1 (set) |
| **CTCI** | test dataway inhibit | response in Q field |
| **CTLM** <which> | test LAM | response in Q field<br>which=1…23 |
| **LACK** | LAM acknowledge | Must be called to clear lam pending interrupts |




**6.2.Fig. 5.3: CAMAC commands window**

## 5.9. NIM I/O page

The NIM I/O page is arranged like a real control panel, in order to allow immediate interaction with the I/O section available on the front panel of the unit.
In addition, it is possible to retrieve default settings by pushing the DEFAULT front panel button (just above the RESET button). Default settings are stored with a specific socket command.
Note that not all interactions are allowed (a fuller control is available from socket or scripting), as browser access is considered unsafe from the remote control point of view.




**6.2.1.Fig. 5.4: NIM I/O settings**

### 5.9.1. Input section

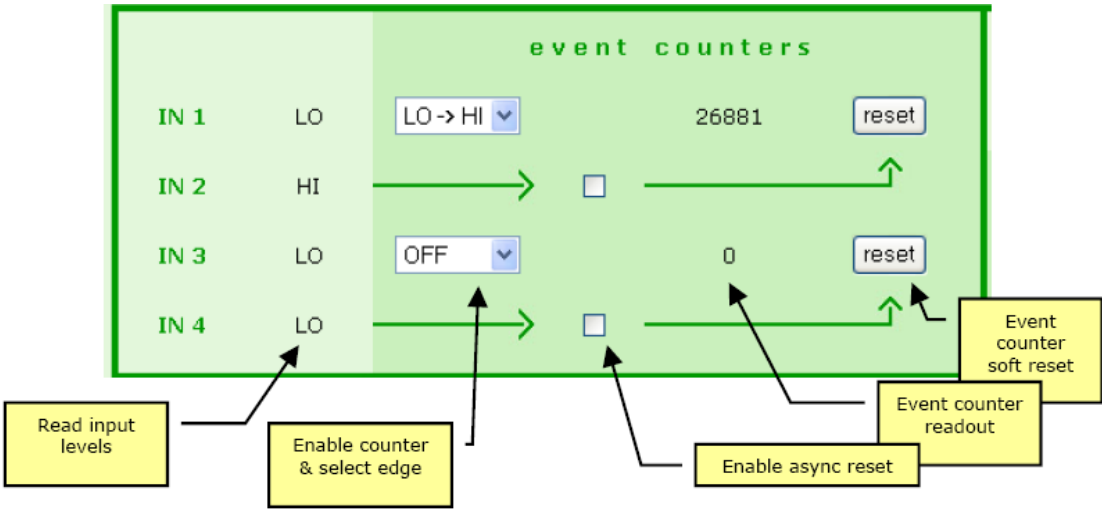



**Fig. 5.5: Input section settings**

– two event counters can be enabled on inputs 1 and 3 independently, by selecting the required triggering transition (HI-to-LO or LO-to-HI) in the drop-down box

6.2.2.– event counter on input 1 can be asynchronously reset by input 2 (if the checkbox is flagged); there is also a button on the page that allows a software reset of the counter

– event counter on input 3 can be asynchronously reset by input 4 (if the checkbox is flagged); there is also a button on the page that allows a software reset of the counter

## 5.9.2. Output section

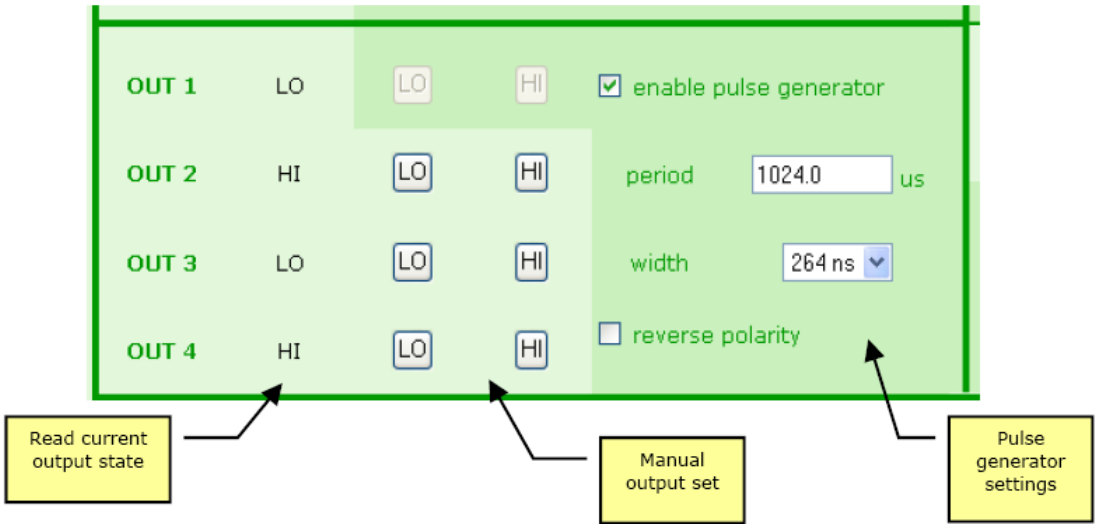



**Fig. 5.6: Output section settings**

– output 1 can be set as a programmable pulse generator, for which the period, pulse width and polarity can be specified
– numerical entry of pulse generator period is automatically adjusted to fit the available resolution when the page is reloaded

## 5.9.3. COMBO section

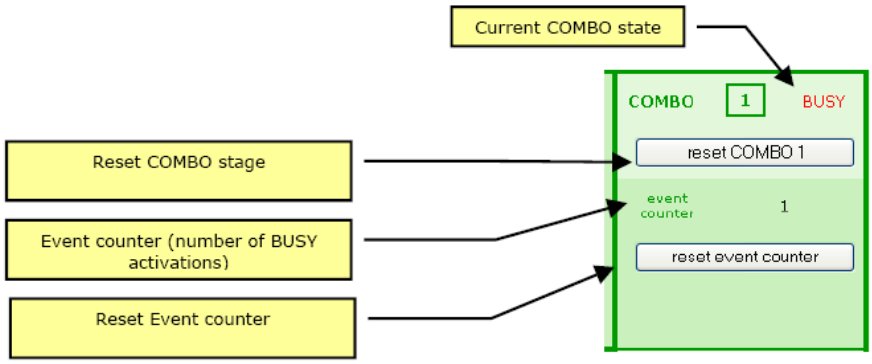



**Fig. 5.7: COMBO section settings**

– COMBO input 1 can be reset with the dedicated button; the usual way to reset a COMBO input would be from software
– COMBO input 2 can be reset with the dedicated button; the usual way to reset a COMBO input would be from software
– Dead Time Counter for both COMBO inputs is not shown on web page, as it has relevant meaning only immediately before resetting the COMBO input.

## 5.10. System settings

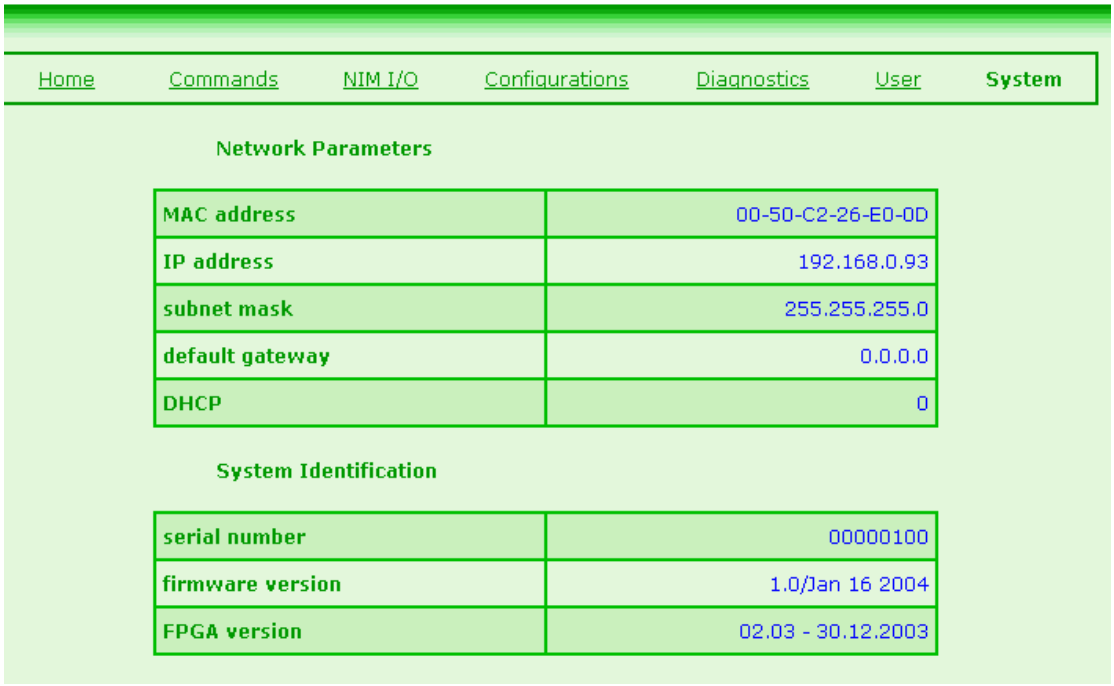



**Fig. 5.8: System settings**

This is a read-only page that displays relevant network settings and local ID details; please always check that your documentation is referring to the same firmware version (release date is NOT relevant).
The MAC address is a read-only property that cannot be changed in any way, it may be useful in certain network environments; the local IP address, subnet mask, default gateway and DHCP enable flag can be modified from the serial port console (see **Serial Port Control** section) or form the control socket (take into account that these settings are effective only after rebooting). If DHCP = 1, then the local DHCP client is enabled. Please refer to your system administrator for additional information relevant to these settings.
Note that wrong or conflicting IP address settings are the most typical issue that creates connection problem when first using the system.
Before connecting a board with static IP (DHCP = 0), you can perform an additional check by issuing a PING command, to verify that the IP address on the unit is really available. If another system is answering at the same address, you may experience intermittent failure (i.e., the web page sometimes does not reload and all other communications will fail).

## 5.11. Diagnostics page

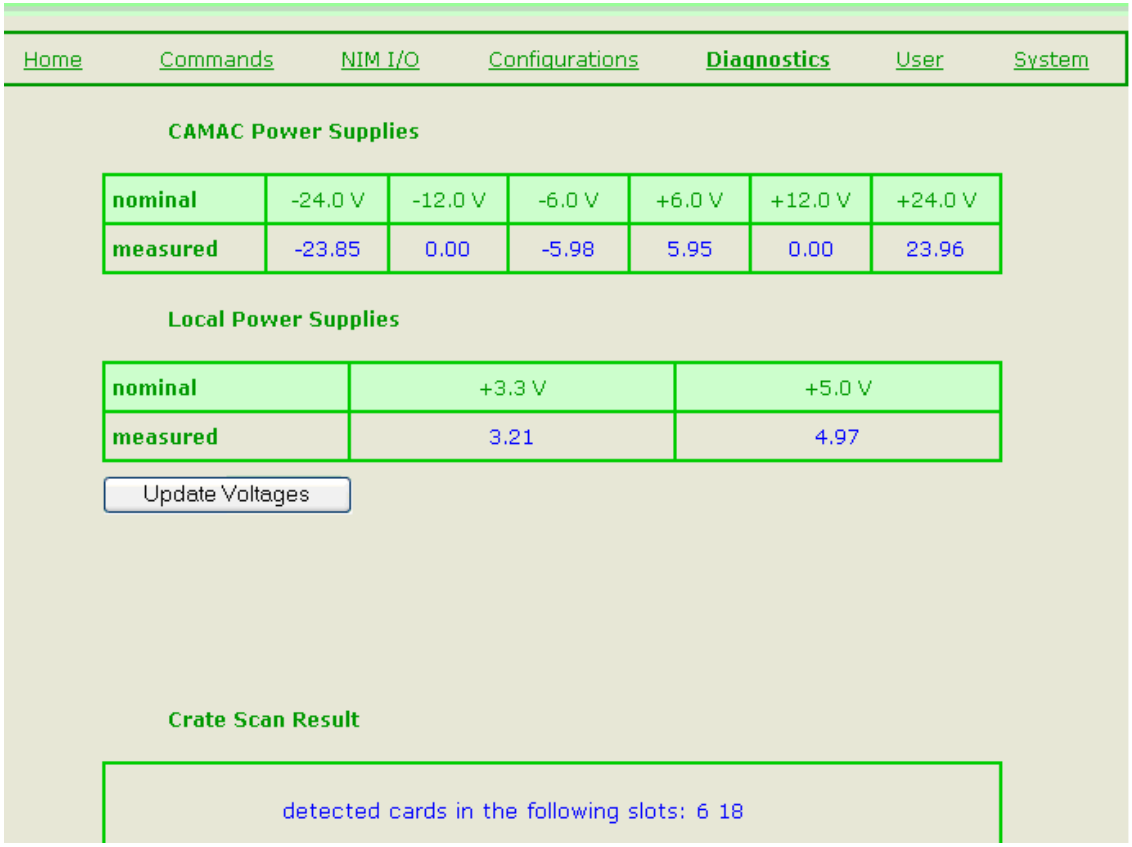



**Fig. 5.9: Diagnostics readout**

This page shows current voltage readouts, divided into crate power supplies and local (digital-only) power supplies.
Note that C111C requires the following voltages to be present in order to work properly: -24V, -6V, +6V, -24V.

On the bottom of the page, results of the Crate Scan (performed only at power-up if the CSCAN flag is enabled, see **Startup Options** section) are shown in textual form. Remember that if Crate Scan is problematic (depending on which cards are inserted into the crate) it can be disabled either by serial or control socket.

## 5.12. SNTP client

Firmware Rev.2.10 and newer feature the SNTP client. As the system is started, the shell script /app/start is executed; the firmware contains the command line:

```
sh /data/custom_start
```

Normally the shell script custom_start is not present, therefore the command execution is neglected.
The User can add the fore mentioned shell script in order to execute additional commands to be performed at system boot, for example to update the system clok via SNTP server;
For example, the shell script custom_start can be created by typing at prompt:

```
echo "/app/msntp -r -l /ram/msntp.pid -P no 192.168.0.1" > /data/custom_start
```

The SNTP client is hosted in the folder /app; the executable filename is msntp (it is recommended to be used exclusively as a client)

The command line options are as follows

==========

```
msntp [ --help | -h | -? ] [ -v | -V | -W ]
    [ { -r | -a } [ -P prompt ] [ -l lockfile ] ]
    [ -c count ] [ -e minerr ][ -E maxerr ]
    [ -d delay | -x [ separation ] [ -f savefile ] ]
    [ address(es) ] ]
```

--help, -h and -? all print the syntax of the command.

-v indicates that diagnostic messages should be written to standard error, and -V requests more output for investigating apparently inconsistent timestamps. -W requests very verbose debugging output, and will interfere with the timing when writing to the terminal (because of line buffered output from C); it is useful only when debugging the source. Note that the times produced by -V and -W are the corrections needed, and not the error in the local clock.

-r indicates that the system clock should be reset by 'settimeofday'. Naturally, this will work only if the user has enough privilege.

-a indicates that the system clock should be reset by 'adjtime'. Naturally, this will work only if the user has enough privilege.

-x indicates that the program should run as a daemon (i.e. forever), and allow for clock drift.

The default is to write the current date and time to the standard output in a format like '1996 Oct 15 20:17:25.123 + 4.567 +/- 0.089 secs', indicating the estimated true (local) time and the error in the local clock. In daemon mode, it will add drift information in a format like ' + 1.3 +/- 0.1 ppm', and display this at roughly 'separation' intervals.

'minerr' is the maximum ignorable variation between the clocks. Acceptable values are from 0.001 to 1, and the default is 0.1 if 'address' is specified and 0.5 otherwise.

'maxerr' is the maximum value of various delays that are deemed acceptable. Acceptable values are from 1 to 60, and the default is 5. It should sometimes be increased if there are problems with the network, NTP server or system clock, but take care.

'prompt' is the maximum clock change that will be made automatically. Acceptable values are from 1 to 3600, and the default is 30. If the program is being run interactively, larger values will cause a prompt. The value may also be 'no', and the change will be made without prompting.

'count' is the maximum number of NTP packets to require. Acceptable values are from 1 to 25 if 'address' is specified and '-x' is not, and from 5 to 25 otherwise; the default is 5. If the maximum isn't enough, you need a better consistency algorithm than this program uses. Don't increase it.

'delay' is a rough limit on the total running time in seconds. Acceptable values are from 1 to 3600, and the default is 15 if 'address' is specified and 300 otherwise.

'separation' is the time to wait between calls to the server in minutes if 'address' is specified, and the minimum time between broadcast packets if not. Acceptable values are from 1 to 1440 (a day), and the default is 300.

'lockfile' may be used in an update mode to ensure that there is only one copy of msntp running at once. The default is installation-dependent, but will usually be /etc/msntp.pid.

'savefile' may be used in daemon mode to store a record of previous packets, which may speed up recalculating the drift after msntp has to be restarted (e.g. because of network or server outages). The default is installation-dependent, but will usually be /etc/msntp.state. Note that there is no locking of this file, and using it twice may cause chaos.

'address' is the DNS name or IP number of a host to poll; if no name is given, the program waits for broadcasts. Note that a single component numeric address is not allowed.

# 6. Local scripting

## 6.1. Lua scripting language

An on-board script interpreter is available, allowing complex interactions with the CAMAC bus and local NIM I/O section. The scripting language is Lua, extended with a TCP/IP library and with specific commands that allow management of the underlying hardware.
Lua is a powerful, lightweight programming language designed for extending applications, frequently used as a general-purpose, stand-alone language. More information is available at www.lua.org.
Please take not that, while being free software, it is property of Tecgraf (http://www.tecgraf.puc-rio.br/), of which we acknowledge the excellent work.
A brief description of the scripting engine and its extensions follows.

**Table 6.1: Lua description**

| | | |
|---|---|---|
| Lua | Version 4.0 | This is the base scripting engine. It has been conceived as an efficient, compact add-on scripting library for various applications. |
| Luasocket library | Version 1.4 | Extension to Lua 4.0 (developed by Diego Nehab) that adds TCP and UDP functionality to the Lua scripting language. |
| Bit manipulation extension | -- | Added by CAEN srl to offer bit-wise AND, OR, XOR functions |
| NIM I/O extension | -- | Added by CAEN srl to offer full control of the local NIM I/O section |
| System extension | -- | Added by CAEN srl to offer full control of system functions |
| CAMAC extension | -- | Added by CAEN srl to offer full control over CAMAC commands and functions. |

Note that a complete reference of Lua is available on www.lua.org and on the C111C support site (courtesy of the Lua community) at
http.//www.caen.it/nuclear/product.php?mod=C111C

## 6.2. Lua engine in C111C

One of the desirable features of Lua is that the language can be easily extended with new commands; this technique has been applied to allow full control of C111C from a script.
A detailed reference of available extension commands is presented in chapter 9 (**Commands Reference**).
A dedicated application that connects to the control socket server allows the user to load the script and control its execution.
The script is launched and executed directly; in case of error, the FAULT red LED on the front panel is lit and script execution is halted. By issuing a **stop** command it is possible to restore the script engine to idle state.
The special function **doevents()** has been added to deal with the single-threaded nature of the scripting engine; it allows the system to terminate execution of the script itself. If this call is missing or called rarely, then it may not be possible to halt execution of the current script.
The ROB (Run-On-Boot) dedicated flag is available on the local EEPROM to indicate whether the FLASH script should be executed at startup. Note that there is no assumption of the temporal evolution coded into the script; therefore, many different uses may be made of the scripting capabilities.

## 6.2.1. Bit manipulation extension

As the base Lua library does not provide bit manipulation operands, CAEN added some commands to allow binary operations, an essential feature for any embedded system. As an example, the CLMR Camac function returns the current LAM mask, and a binary AND operator is almost mandatory to allow individual bit testing.
The following additional functions are provided, all with two operands and one result:

**Table 6.2: Lua additional functions**

| function | Description | C equivalent |
|---|---|---|
| band(a,b) | 32-bit binary AND | a & b |
| bor | 32-bit binary OR | a \| b |
| bxor() | 32-bit binary XOR (exclusive-OR) | a ^ b |
| bmod() | binary module | a % b |
| bsl | binary shift left | a << b |
| bsr | binary shift right | a >> b |

## 6.2.2. Socket commands for Lua control

A subset of control socket commands is dedicated to management of the local Lua interpreter engine; these commands are used by the jsm application (C111C Script Manager, see below). Note that these socket commands are the only messages to violate the principle to have one command per line. The following commands are available:

**Table 6.3: Lua Socket commands**

| | |
|---|---|
| lua_setfile | It transfers a script from host to C111C; the file is placed in RAM and can be saved on FLASH with the lua_store command. The following procedure is required:<br>• host sends to control socket the following command:<br>**lua_setfile <filesize>** where <filesize> is expressed in bytes<br>• control sockets answers with "OK"<br>• host sends the file directly<br>• control socket answers with "OK" |
| lua_getfile | It transfers a script from C111C to host; the following procedure is required:<br>• host sends to control socket the following command:<br>**lua_getfile**<br>• control sockets answers with <filesize> (expressed in bytes)<br>• host sends "OK"<br>• control socket sends the file directly |
| lua_store | It saves the current script on FLASH |
| lua_getrun | It returns the current execution state of the script interpreter |
| lua_setrun | It changes the executionstate: lua_setrun <value>, where 1 = run, 0 = stop |
| lua_geterr | It returns the error message (if any) returned by the script interpreter; being a multi-line string, it follows the same protocol of lua_getfile |
| lua_getlog | It returns the stdout log file returned by the script interpreter; it's useful as a debugging aid as print() messages are sent to the log. Being a multi-line output, it follows the same protocol of lua_getfile. WARNING: using print() on Lua may crash the system if the log file gets too long. Please use it only for debug !!!! |

7.2.3.You can review the JSM source code to gain more insight into script file transfers. Please note that JSM is provided in source code form "as is", without support or guarantee.

## 6.2.3. C111C Script Manager

It is a dedicated application, available for Windows and Linux, that allows full control over all operations related to script management; all operations are specified with command line parameters. The following syntax is implemented (version 1.0):

**Table 6.4: Script Manager commands**

| | |
|---|---|
| jsm -h | displays program version and a list of allowed parameters |
| jsm -ip <IP addr> -u <filename.ext> | uploads script text from specified file on host to C111C |
| jsm -ip <IP addr> -run | starts execution of current script |
| jsm -ip <IP addr> -stop | halts execution of current script |
| jsm -ip <IP addr> -s | stores current script on non volatile memory for Run-on-Boot option |
| jsm -ip <IP addr> -rob <value> | sets rob (Run-on-Boot) flag to specified value (0 or 1) |
| jsm -ip <IP addr> -d <filename.ext> | downloads script text from C111C to specified file on host |
| jsm -ip <IP addr> -d stdout | downloads script text from C111C to stdout on host |
| jsm -ip <IP addr> -e <filename.ext> | stores error message (if any) from C111C to specified file on host |
| jsm -ip <IP addr> -e stdout | stores error message (if any) from C111C to stdout on host |
| jsm -ip <IP addr> -l <filename.ext> | stores log message (if any) from C111C to specified file on host |
| jsm -ip <IP addr> -l stdout | stores log message (if any) from C111C to stdout on host |

The jsm application is available in both source and compiled form on the documentation section of the C111C web site (http://www.caen.it/nuclear/product.php?mod=C111C); it uses dedicated commands to transfer files. Please check periodically for updates.

## 6.2.4. Scripting on C111C

A few usage examples follow.

**Table 6.5: Script usage examples**

| | |
|---|---|
| **Crate initialization** | In certain cases, it may be safe to initialize inserted CAMAC target cards as soon as possible after power-up.<br>With ROB = 1, the FLASH script performs the required initialization, terminating after completion<br>`jn_led(1,1)  -- turn LED U1 on`<br>`run_once_init()  -- function somewhere else in the script`<br>`jn_led(1,0)  -- turn LED U1 off` |
| **Automatic execution of monitoring loop** | After a run-once initialization section, an infinite loop is executed, calling as often as possible the doevents() function:<br>`jn_led(1,1)  -- turn LED U1 on`<br>`run_once_init()  -- function somewhere else in the script`<br>`while (1) do`<br>`  doevents()`<br>`  run_in_loop() --  function somewhere else in the script`<br>`  pause (100)  -- wait 100 msec`<br>`end` |
| **COMBO servicing** | `jn_led(1,1)  -- turn LED U1 on`<br>`run_once_init()  -- function somewhere else in the script`<br>`while (1) do`<br>`  doevents()`<br>`  if (nim_testint(1) == 1) then`<br>`  do_something() -- function somewhere else in the script`<br>`  nim_cack(1)`<br>`  end`<br>`end` |

# 7. Firmware Upgrade

It is possible to upgrade a section of FLASH memory contents in order to allow firmware upgrades on the field, either to correct any problems that may show up during usage or to load application-specific executables.
Internal FLASH is structured into two banks: one for the operating system, and one for the application; the application bank includes all the executables related to C111C.
Note:
*When using a NFS-mapped disk, please remember to add the following line:*
*`<nfs_directory> <IP address JNT01>(rw,all_squash)`*
*to the **/etc/exports** file on the computer where disk is located.*

Firmware upgrade (limited to the application bank) is performed using a telnet connection to the unit, as follows:

- copy the new binary file on a known location on a network disk
- establish a telnet connection on default port 23 (please note that, depending on fw version, it may be possible that the internal telnet server must be enabled by means of HW jumpers); of course, you must know the unit IP address
- type the following commands:

```
cd app
sh flash <host:/nfs_directory> <jffs2 filename>
```

and wait until reprogramming completes

- reboot the unit (either by pressing the RESET button on the front panel or by typing "*reboot*" from the telnet terminal window).

An example of a typical fw upgrade command line is the following:

```
sh flash 192.168.0.91:/home/jenet2/fwupgrade jenet2.img
```

## 7.1. Firmware Upgrade for first generation modules

First generation modules need a newer kernel (file: jenet2_kernel.bin 1 available at http://www.caen.it/nuclear/product.php?mod=C111C web page) before firmware upgrading; the upgrade procedure is therefore the following:

Procedure Start:

Connect to the Unit via TELNET (module IP, port 23)
the following text will be displayed:

```
BusyBox v0.60.3 (2003.03.19-17:07+0000) Built-in shell (msh)
Enter 'help' for a list of built-in commands.

#
```

Now at the prompt type:

*ls*

the following text will be displayed:

```
BusyBox v0.60.3 (2003.03.19-17:07+0000) Built-in shell (msh)
Enter 'help' for a list of built-in commands.

# ls
data    etc     lib     nfs     ram     usr  bin
```

```
dev    htdocs  mnt    proc    sbin  www
#
```

If the “www” directory does not appear, but instead the “app” directory appears, then the module is a “new generationn C111C” and therefore it is not necessary to update the kernel, prior to update the firmware, that can be done by following the instructions at § 7.
The presence of the “www” directory indicates that the module is a “first generation C111C” and it is therefore necessary to continue the procedure to upgrade the kernel:

at the prompt, type:

*mount-t nfs-o nolock <nfs-shared-folder> / nfs*
*eraseall / dev/mtd/1*
*eraseall / dev/mtd/4*
*update_flash t-v-ram / nfs/jenet2_kernel.bin 1*
*reboot*

Wait for the reboot, the telnet connection will end automatically.

Reconnect with telnet

at the prompt, type:

*mount-t nfs-o nolock <nfs-shared-folder> / nfs*
*update_flash t-v-ram / nfs/jenet2_caen_2008_07_09.img 4*
*eeprom-e "APPDATAMOUNT = yes"*
*reboot*

Procedure End.

# 8. NIM subsection

Please note that on the present document the following notation is used for NIM signals:

**LO** No current flowing into load

**HI** Current flowing into load (corresponding to a –0.8 V voltage level across a 50 ohm load)

This notation is maintained also on the NIM I/O web page.
A command parameter equal to 1 means HI.

## 8.1. Default button

A DEFAULT pushbutton, located on the front panel above the reset section, allows immediate manual reload of a default configuration for the NIM I/O subsection, thus allowing a quick reconfiguration of the system.
The same settings are applied at power-up, and can be set through the control socket.
The green LED located just below the DEFAULT pushbutton is turned on when default settings are applied, and turned off whenever any of the relevant settings is altered, providing an immediate visual feedback of the validity of default settings.
The DEFAULT pushbutton can also generate a special interrupt request and notify the host computer through a dedicated socket connection on port 2002. This is a very powerful feature that allows the user to start different programs at each pressure of the button: for example, different module setups can be activated when the button is pressed and different actions can be performed.

## 8.2. Inputs

The NIM INPUT subsection implements four independent NIM inputs that may be read asynchronously to retrieve input status or configured to perform event counting; more specifically, inputs 1 and 3 can be set as event counter, triggering on rising or falling transition. Counter reset is performed either with a dedicated control command or with an external reset, derived from input 2 (for counter on input 1) and from input 4 (for counter on input 3). Note that external reset capability must be enabled with the proper commands. External reset is active when relevant input is HI; while HI, counter is kept to zero and will not count further.

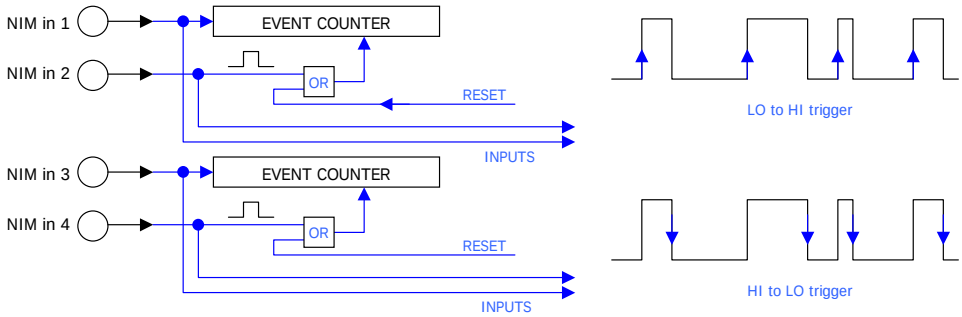



**Fig. 8.1: NIM INPUT subsection diagram**

**Table 8.1: NIM INPUT subsection**

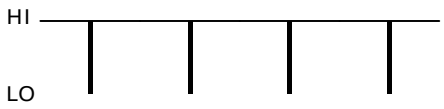
| **Read from inputs** | | **Notes** |
|---|---|---|
| TCP socket commands | Lua code snippet | Basic reading of input values (j=1,2,3,4) |
| `nim_getin`<br>`nim_getin j` | `A = nim_getin();`<br>`B = nim_getins(j)` | |
| **Set event counter on IN 3 to falling edge** | | |
| TCP socket commands | Lua code snippet | |

| | | |
|---|---|---|
| `nim_setievcnt 3 1 1 0` | `nim_setievcnt(3,1,1,0)` | |
| **Enable async reset for counter on IN 1** | | |
| TCP socket commands | Lua code snippet | |
| `nim_setievcnt 1 1 1 0` | a,b,c=nim_getievcnt(1);<br>nim_setievcnt(1,a,b,1) | |

## 8.3. Outputs

The OUTPUT subsection implements four independent NIM output that can be independently set and reset; in addition, a programmable pulse generator that can be enabled on the first output.

**Fig. 8.2: NIM OUTPUT subsection diagram**

| **PULSE GENERATOR** | |
|---|---|
| Period | 186.2 μs to 95325.2 μs<br>(in 93.1 μs steps, 10791 Hz base clock) |
| Width | 88 ns to 616 ns |
| Output polarity | Direct   |
| | Reverse   |

Please note that duty cycle is never higher than 0,05 % (with reversed polarity flag disabled), therefore it may be difficult in certain cases to see the pattern on a scope.

**Table 8.2: NIM OUTPUT subsection**

| **Write to outputs** | | **Notes** |
|---|---|---|
| TCP socket commands | Lua code snippet | Basic output control<br>out=1,2,3,4<br>val=0,1 |
| `nim_setout 1 1 1 1`<br>`nim_setouts <out> <val>` | `nim_setout(1,1,1,1)`<br>`nim_setouts(2,0)` | |
| **Set pulse generator to 1 ms period, 440 ns width** | | |
| TCP socket commands | Lua code snippet | 11*93.1 = 1,024 ms<br>5*88 = 440 ns |
| `nim_setpulse 11 5 0` | `nim_setpulse(11,5,0)` | |
| **Turn pulse generator off and activate outputs 1,3** | | |
| TCP socket commands | Lua code snippet | |
| `nim_pulseoff`<br>`nim_setouts 1 1`<br>`nim_setouts 3 1` | `nim_pulseoff()`<br>`nim_setouts(1,1)`<br>`nim_setouts(3,1)` | |

## 8.4. COMBO I/O

The COMBO I/O subsection implements a commonly requested Trigger/Busy functional block. The diagram below details one of the two COMBO subsections.

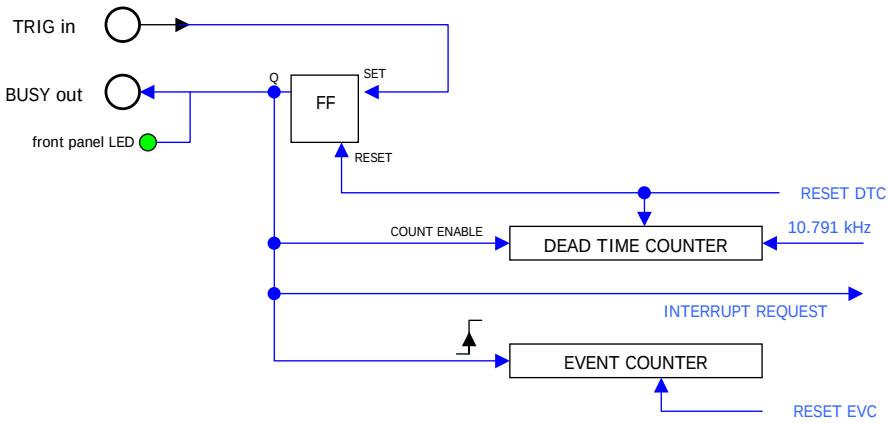



**Fig. 8.3: COMBO I/O subsection diagram**

Whenever a LO-to-HI transition occurs on the TRIG input, an internal Flip-Flop is set to capture the event; the Flip-Flop output is connected to the BUSY output and its associated LED. The **Dead Time Counter** starts counting at a 10.791 kHz rate, and it is reset when the software application resets the Flip-Flop; therefore, the Dead Time Counter provides an indication of the service time of the TRIG input. It is automatically reset when BUSY is reset (therefore it must be read before the BUSY reset command).
An independent **Event Counter** is incremented at each LO-to-HI transition of the BUSY output, providing an indication of the number of pulses. The Event Counter can be reset by means of an explicit command (through control socket) or from the NIM I/O web page.
Please note that, in order to be ready to accept new events, the COMBO section must be explicitly served by the user, in one of the following ways: with a script section that resets the relevant COMBO FF; within the application running on host, with a routine that in response to the COMBO event resets the relevant COMBO FF; by clicking on the RESET button on the NIM I/O web page.

**Table 8.3: COMBO I/O subsection**

| **COMBO I/O** | |
|---|---|
| Event Counter | Incremented on BUSY output rising edge |
| Trigger event | TRIG input rising edge |
| Dead Time Counter | 1 (92.67 usec) to 65535 (6.7 sec) |
| TRIG-to-BUSY response | 35 ns |

**Table 8.4: COMBO I/O subsection examples**

| **Acknowledge COMBO 1 trigger** | | **Notes** |
|---|---|---|
| TCP socket commands | Lua code snippet | |
| `nim_cack 1` | `nim_cack(1)` | |
| **Wait for TRIG on 1 and then turn NIM outs 3,4 ON** | | |
| TCP socket commands | Lua code snippet | |
| --- | nim_waitint(1); nim_cack(1)<br>jn_led(3,1); jn_led(4,1) | Blocking mode (wait) not available on socket |
| nim_testint 1 {repeat then}<br>nim_cack 1<br>jn_led 3 1<br>jn_led 4 1 | if (nim_waitint(1) == 1) then<br>  nim_cack(1); jn_led(3,1); jn_led(4,1)<br>end | Test mode |

# 9. ASCII Commands reference

A reference of available commands on both the TCP control socket server and the local Lua scripting language is detailed in this section.
Note that whenever possible, TCP control commands are as short as possible in order to minimize Ethernet traffic; on the other hand, Lua commands are more descriptive.
Some general rules follow:

- Control socket commands ALWAYS return an error code as first parameter; it is equal to 0 if the commands executed with success, -1 if command parameters are wrong, -2 if the command is non existent; in the table below this error code is NOT indicated when describing return values, as it must be always 0 to yield a correct answer.
- TCP control sockets are not case sensitive, while Lua commands are case sensitive (this is a specific property of the language).
- As much as possible, all commands have the same name for Lua and for TCP control socket.

**Table 9.1: TCP control socket / Lua Commands reference**

| TCP control socket | Lua | Description |
|---|---|---|
| **CAMAC bus control** | | |
| `CCCZ` | `CCCZ()` | Generate Dataway Init |
| `CCCC` | `CCCC()` | Generate Crate Clear |
| `CFSA <function> <slot> <addr> <data>` | `CFSA(function,slot,addr,data)` | 24-bit CAMAC command; returns Q and data |
| `CSSA <function> <slot> <addr> <data>` | `CSSA(function,slot,addr,data)` | 16-bit CAMAC command; returns Q and data |
| `CCCI <value>` | `CCCI(value)` | Change Dataway Inhibit to specified value (0 or 1) + Z Cycle |
| `CTCI` | `CTCI()` | CAMAC test Inhibit; returns 0 or 1 |
| `CTLM <slot>` | `CTLM(slot)` | CAMAC test LAM on specified slot = 1…..23 |
| `CCLWT <slot>` | `CCLWT(slot)` | CAMAC wait for LAM on specified slot (only for Lua) |
| `CLMR` | `CLMR()` | Returns current LAM register, in hex |
| `LACK` | `LACK` | LAM acknowledge |
| `CTSTAT` | `CTSTAT()` | Returns Q and X values (from last access on bus) |
| `CSCAN` | | Executes a Crate scan and returns a bit mask with bitn = 1 if in the slot n a CAMAC board is detected |
| **DIAGNOSTIC SECTION** | | |
| `vn24` | `vn24()` | Returns the measured voltage on –24V power supply, in float format |
| `vn12` | `vn12()` | Returns the measured voltage on –12V power supply, in float format |
| `vn6` | `vn6()` | Returns the measured voltage on –6V power supply, in float format |
| `vp6` | `vp6()` | Returns the measured voltage on +6V power supply, in float format |

| | | |
|---|---|---|
| vp12 | vp12() | Returns the measured voltage on +12V power supply, in float format |
| vp24 | vp24() | Returns the measured voltage on +24V power supply, in float format |
| vp33 | vp33() | Returns the measured voltage on +3.3V power supply, in float format |
| vp5 | vp5() | Returns the measured voltage on +5V power supply, in float format |
| **SYSTEM PARAMETERS (stored in EEPROM)** | | |
| ee_getcomspeed | --- | Returns the speed of the RS232 COM port |
| ee_setcomspeed <baudrate> | --- | Sets the speed of the RS232 COM port |
| ee_getcscan | --- | Returns current Crate Scan flag value (0 or 1) |
| ee_getdhcp | ee_getdhcp() | Returns 0 if DHCP client is not enabled, 1 otherwise |
| ee_getdns | ee_getdns() | Returns current DNS, in dotted notation |
| ee_getgw | ee_getgw() | Returns current Gateway, in dotted notation |
| ee_getip | ee_getip() | Returns current IP address, in dotted notation |
| ee_getmac | ee_getmac() | Returns current MAC address, in hex format with '-' delimiters, like in "00-50-C2-26-E0-0A" |
| ee_getmask | ee_getmask() | Returns current IP mask, in dotted notation |
| ee_getname | --- | Returns current Crate Name as it appears in the local web pages |
| ee_getrob | --- | Returns current Run-on-Boot flag value (0 or 1) |
| ee_getserial | --- | Returns C111C serial number |
| ee_setcscan | --- | Sets Crate Scan flag to specified value (0 or 1) |
| ee_setname <name string> | --- | Sets the Crate Name shown in the local web pages |
| ee_setrob <value> | --- | Sets Run-on-Boot flag to specified value (0 or 1) |
| ee_storeconf | --- | Stores current NIM section configuration into EEPROM default settings |
| **NIM I/O SECTION** | | |
| nim_getin | nim_getin() | Returns NIM input values; it returns "a(1) a(2) a(3) a(4)", where a(n) = 0 or 1 |
| nim_getins <which> | nim_getins(which) | Returns a single NIM input value (0 or 1); <which> = 1, 2, 3 or 4 |
| nim_setievcnt <which> <en> <pol> <ext_reset> | nim_setievcnt(which,en,pol,ext_reset) | Sets Input Event Counter; <which>=1,3; <en>=0,1; <pol>=0,1; <ext_reset >=0,1 |
| nim_getievcnt <which> | nim_getievcnt(which) | Returns Input Event Counter settings |
| nim_geticnt <which> | nim_geticnt(which) | Returns current Input Event Counter value |
| nim_reseticnt <which> | nim_reseticnt(which) | Reset specified Input Event Counter: <which> = 1 or 3 |

| | | |
|---|---|---|
| nim_getouts <which> | nim_getouts(which) | Returns current value of specified output; <which> = 1…4 |
| nim_getout | nim_getout() | Returns current value of all outputs |
| nim_setouts <which> <value> | nim_setouts(which,value) | Sets value of specified output; <which> = 1…4 |
| nim_setout <v1> <v2> <v3> <v4> | nim_setout(v1,v2,v3,v4) | Sets current value of all output; <which> = 1…4 |
| nim_setoutp <which> <pulse_width> | --- | Generates a pulse event on a selected output with specified width in multiples of 20 ms. See section **Outputs** for details |
| nim_setpulse <period> <width> <polarity> | nim_setpulse(period,width,polarity) | Sets Pulse Generator, values in decimal; <period>=1…1023; <width>=1…7; <polarity>= 0 or 1. See section **Outputs** for details |
| nim_getpulse | nim_getpulse() | Returns Pulse Generator settings |
| nim_pulseoff | nim_pulseoff() | Disables Pulse Generator |
| nim_setcthr <which> <value> | nim_setcthr(which, value) | Sets threshold value for COMBO section; <which> = 1 or 2 |
| nim_getcthr <which> | nim_getcthr(which) | Returns current threshold value for COMBO section; <which> = 1 or 2 |
| nim_getcdtc <which> | nim_getcdtc(which) | Returns current COMBO Dead Time Counter value; <which> = 1, 2 |
| nim_cack <which> | nim_cack(which) | Acknowledges COMBO event,; <which> = 1 or 2 ; reset DTC and FF |
| nim_getcev <which> | nim_getcev(which) | Returns current COMBO Event Counter value; <which> = 1, 2 |
| nim_resetcev <which> | nim_resetcev(which) | Reset specified COMBO Event Counter: <which> = 1 or 2 |
| nim_enablecombo <which> <value> | nim_enablecombo(which, value) | Enables or disables specified COMBO section, preventing unwanted triggering; <which> = 1, 2; <value>= 0 (enable) ,1(disable) |
| --- | nim_waitcombo(ch) | Wait for COMBO interrupt; it returns only when COMBO is busy (blocking call) ; ch = 1, 2 or 3 (= both) |
| --- | nim_waitdtc(ch) | Wait for DTC interrupt; it returns only when DTC has crossed the threshold (blocking call) ; ch = 1, 2 or 3 (= both) |
| nim_testcombo <ch> | nim_testcombo (ch) | Test COMBO interrupt; it immediately returns current values (1 if COMBO busy, 0 otherwise); ch = 1, 2 or 3 (= both) |
| nim_testdtc <ch> | nim_testdtc(ch) | Test DTC interrupt; it immediately returns current value (1 if DTC has crossed the threshold, 0 otherwise) ; ch = 1, 2 or 3 (= both) |
| **Control socket only commands** | | |
| lua_setfile <data.....> | -- | Lua-related command; enables direct transfer of script file |
| lua_store | -- | Lua-related command; stores transferred filew into non-volatile memory |
| lua_getfile | -- | Lua-related command; enables direct retrieval of script file |
| lua_getrun | -- | Lua-related command; returns 0 if script is stopped, 1 if running |

| | | |
|---|---|---|
| `lua_setrun <value>` | `--` | Lua-related command; <value>=1 runs the script; <value>=0 stops the script |
| `lua_geterr` | `--` | Lua-related command; returns last Lua error message |
| `lua_getlog` | `--` | Lua-related command; returns log file (in place of stdout) |
| **SYSTEM IDENTFICATION and VARIOUS** | | |
| `jn_fpgaver` | `jn_fpgaver()` | Returns a string containing FPGA details (read-only information from FPGA registers) |
| `jn_fwver` | `jn_fwver()` | Returns a string containing the current firmware version running on the system |
| `jn_led <which> <value>` | `jn_led(which,value)` | Set front panels LEDs (U1, U2, U3, U4); <which> = 1 to 4, <value> = 0 or 1 |
| `reset` | `----` | Perform a board reset |
| `user_add <username>:<password>` | `----` | Add a new user to the local web server |
| `user_del <username>:<password>` | `----` | Delete a user from the local web server |
| `user_list` | `----` | List all users of the local web server |
| `ver` | `----` | Returns a string containing firmware and FPGA versions |
| `web_getuser` | `web_getuser()` | Returns text appearing in User page (see web server section) |
| `web_setuser <text>` | `web_setuser(text)` | Sets text that appears in User page (see web server section) |
| **Lua only commands** | | |
| `--` | `doevents()` | Enable system control of Lua loop |
| `--` | `pause(ms)` | Wait for specified interval (in ms) |
| | `band(a,b)` `bor(a,b)`<br>`bxor(a,b)` `mod(a,b)`<br>`bsl(a,b)` `bsr(a,b)` | Binary operators:<br>AND: a & b OR: a \| b<br>XOR: a ^ b MOD: a % b<br>BSL: a << b BSR: a >> b |

# 10. Block transfer reference

A brief summary of available commands follows:

**Table 10.1: Block transfer commands**

| | | |
|---|---|---|
| Utility | BLKBUFFS | Block transfer buffer size set |
| | BLKBUFFG | Block transfer buffer size get |
| Q-stop | BLKSS | Block transfer, 16-bit, Q-stop mode |
| | BLKFS | Block transfer, 24-bit, Q-stop mode |
| Q-repeat | BLKSR | Block transfer, 16-bit, Q-stop mode |
| | BLKFR | Block transfer, 24-bit, Q-repeat mode |
| Address Scan | BLKSA | Block transfer, 16-bit, address scan mode |
| | BLKFA | Block transfer, 24-bit, address scan mode |
| In general the command is expressed as **BLKsm**<br>where s = S (short), F(full)<br>m = S (Q-stop), R (Q-repeat), A (address scan)<br>Read or write mode is determined by the Function code passed as a parameter, as follows:<br>F = 0,……,7 ➔ READ mode<br>F = 16,…,27 ➔ WRITE mode | | |

All block transfer commands have the same behavior. C111C replies to the command itself immediately after reception, before executing the actual block transfer, with one of the following possible replies (compliant with the standard command response of the TCP control socket protocol):

**Table 10.2: Block transfer replies**

| Reply | |
|---|---|
| 0 | OK, operation in progress |
| -1 | error, wrong parameters |
| -2 | error, non existing command |

The general format of a data block is

**hdr data1 data2 ….. dataK**

where:

- **K** is the current buffer size
- in ASCII mode, hdr is formatted as %03d
- in ASCII mode, dataj is formatted as %06X (for both 16-bit and 24-bit access types)
- in ASCII mode, the data block is terminated by a “\r” character
- in binary mode, hdr and dataj are all 32-bit values
- in binary mode, the data block is (K+1)*4 bytes
- if there are non significant data values (if hdr < K, or hdr = 0), data block size is always the same as above

**hdr** can assume one of the following values:

**Table 10.3: HDR possible values**

| hdr | | notes |
|---|---|---|
| 0 | End of block transfer | data1= actual datasize<br>data2,…dataK = non significant |
| N > 0 | Number of data words being transferred | If N<K, then dataN,dataN+1,…..,dataK are non significant |
| -3 | Timeout error | data1= actual datasize<br>data2,…dataK = non significant |
| -4 | Abort error | data1= actual datasize<br>data2,…dataK = non significant |

## 10.1. Block transfer abort

Any block read operation can be aborted by sending an arbitrary character to C111C; C111C will answer with hdr = -4 followed by actual_datasize (the number of datawords effectively transferred). Any block write operation can be aborted by sending a data block with hdr = -4, taking care to maintain data block formatting and size. C111C will answer (always in ASCII, as it has returned to ordinary command mode) with hdr=-4 followed by actual_datasize (the number of datawords effectively transferred).
Note: please take care to avoid multiple clients connected to the control socket server, as any command sent by other clients will abort the data transfer currently ongoing.

**Table 10.4: Block transfer commands**

**Buffer size get/set** (only for read operations)
Default buffer size is 16
Buffer size is expressed in terms of data values (not in bytes)

| command | Reply (by C111C) | Notes |
|---|---|---|
| `BLKBUFFG` | `0 <buffsize>` | Get current buffer size |
| `BLKBUFFS <buffsize>` | `0` | Set buffer size; valid range is 1…256 |

**STOP mode**

`reply = see table on page 2`

K = Block Transfer buffer size

| **ASCII read** | Notes |
|---|---|
| `HOST> BLKFS <F> <N> <A> <maxsize>`<br>`JENET> reply`<br>`JENET> hdr data1 data2 data3 ..... dataK`<br>`JENET> hdr data1 data2 data3 ..... dataK`<br>`.....`<br>`JENET> 000 data1 data2 data3 ..... dataK` | 24-bit operation<br>F = 0…7 |
| `HOST> BLKSS <F> <N> <A> <maxsize>`<br>`------- same as above -------` | 16-bit operation<br>F = 0…7 |
| **ASCII write** | Notes |
| `HOST> BLKFS <F> <N> <A> <maxsize>`<br>`JENET> reply`<br>`HOST> hdr data1 data2 data3 ..... dataK`<br>`HOST> hdr data1 data2 data3 ..... dataK`<br>`.....`<br>`HOST> hdr data1 data2 data3 ..... dataK`<br>`JENET> 0 <actual_datasize>` | 24-bit operation<br>F = 16…27 |
| `HOST> BLKSS <F> <N> <A> <maxsize>`<br>`------- same as above -------` | 16-bit operation<br>F = 16…27 |
| **BINARY read** | Notes |
| `HOST> BLKFS <F> <N> <A> <maxsize> bin`<br>`JENET> reply`<br>`JENET> <binary data>`<br>`JENET> <binary data>`<br>`.....`<br>`JENET> <binary data>` | 24-bit operation<br>F = 0…7 |
| `HOST> BLKSS <F> <N> <A> <maxsize> bin`<br>`------- same as above -------` | 16-bit operation<br>F = 0…7 |

**REPEAT mode**

reply = see table on page 2
K = Block Transfer buffer size
<timeout> in seconds, range = 0,….,32767

| **ASCII read** | Notes |
|---|---|
| `HOST> BLKFR <F> <N> <A> <maxsize> <timeout>`<br>`JENET> reply`<br>`JENET> hdr data1 data2 data3 ..... dataK`<br>`JENET> hdr data1 data2 data3 ..... dataK`<br>`.....`<br>`JENET> 000 data1 data2 data3 ..... dataK` | 24-bit operation<br>F = 0…7<br><br>Check for timeout possible reply from Jenet (hdr = -3) |

| | |
|---|---|
| HOST> BLKSR <F> <N> <A> <maxsize> <timeout><br>------- same as above ------- | 16-bit operation<br>F = 0…7 |
| **ASCII write** | Notes |
| HOST> BLKFR <F> <N> <A> <maxsize> <timeout><br>JENET> reply<br>HOST> hdr data1 data2 data3 ..... dataK<br>HOST> hdr data1 data2 data3 ..... dataK<br>.....<br>HOST> hdr data1 data2 data3 ..... dataK<br>JENET> 0 <actual_datasize> | 24-bit operation<br>F = 16…27<br><br><br><br>Check for timeout possible reply from C111C (hdr = -3) |
| HOST> BLKSR <F> <N> <A> <maxsize> <timeout><br>------- same as above ------- | 16-bit operation<br>F = 16…27 |
| **BINARY read** | Notes |
| HOST> BLKFR <F> <N> <A> <maxsize> <timeout> bin<br>JENET> reply<br>JENET> <binary data><br>JENET> <binary data><br>.....<br>JENET> <binary data> | 24-bit operation<br>F = 0…7<br><br><br>Check for timeout possible reply from C111C (hdr = -3) |
| HOST> BLKSR <F> <N> <A> <maxsize> <timeout> bin<br>------- same as above ------- | 16-bit operation<br>F = 0…7 |
| **ADDRESS SCAN mode**<br>reply = see table on page 2<br>K = Block Transfer buffer size<br>Nstart = station from which address scan begins<br>Nwords = maximum size of data block to transfer | |
| **ASCII read** | Notes |
| HOST> BLKFA <F> <Nstart> <Nwords><br>JENET> reply<br>JENET> hdr data1 data2 data3 ..... dataK<br>JENET> hdr data1 data2 data3 ..... dataK<br>.....<br>JENET> 000 data1 data2 data3 ..... dataK | 24-bit operation<br>F = 0…7 |
| HOST> BLKSA <F> <Nstart> <Nwords><br>------- same as above ------- | 16-bit operation<br>F = 0…7 |
| **ASCII write** | Notes |
| HOST> BLKFA <F> <Nstart> <Nwords><br>JENET> reply<br>HOST> hdr data1 data2 data3 ..... dataK<br>HOST> hdr data1 data2 data3 ..... dataK<br>.....<br>HOST> hdr data1 data2 data3 ..... dataK<br>JENET> 0 <actual_datasize> | 24-bit operation<br>F = 16…27 |
| HOST> BLKSA <F> <Nstart> <Nwords><br>------- same as above ------- | 16-bit operation<br>F = 16…27 |
| **BINARY read** | Notes |
| HOST> BLKFA <F> <Nstart> <Nwords> bin<br>JENET> reply<br>JENET> <binary data><br>JENET> <binary data><br>.....<br>JENET> <binary data> | 24-bit operation<br>F = 0…7 |
| HOST> BLKSA <F> <Nstart> <Nwords> bin<br>------- same as above ------- | 16-bit operation<br>F = 0…7 |

# 11. Binary commands reference

In general, the binary command has the following format:
byte(0) = STX;
byte(1) = CMD_CODE;
byte(2) = databyte(0)
byte(3) = databyte(1)
....
byte(n) = databyte(k)
byte(n+1) = REQ_RESPONSE;
byte(n+2) = ETX;
where:
STX is the hexdecimal value 0x02
ETX is the hexdecimal value 0x04
CMD_CODE may be one of the followings value:
BIN_CFSA_CMD = 0x20 (equivalent to the ascii command cfsa)
BIN_CSSA_CMD = 0x21 (equivalent to the ascii command cssa)
BIN_CCCZ_CMD = 0x22 (equivalent to the ascii command cccc)
BIN_CCCC_CMD = 0x23 (equivalent to the ascii command ccci)
BIN_CCCI_CMD = 0x24 (equivalent to the ascii command ctci)
BIN_CTCI_CMD = 0x25 (equivalent to the ascii command ctci)
BIN_CTLM_CMD = 0x26 (equivalent to the ascii command ctlm)
BIN_CCLWT_CMD = 0x27 (equivalent to the ascii command cclwt)
BIN_LACK_CMD = 0x28 (equivalent to the ascii command lack)
BIN_CTSTAT_CMD = 0x29 (equivalent to the ascii command ctstat)
BIN_CLMR_CMD = 0x2A (equivalent to the ascii command clmr)
BIN_CSCAN_CMD = 0x2B (equivalent to the ascii command cscan)
BIN_NIM_SETOUTS_CMD = 0x30 (equivalent to the ascii command nim_setouts)
databyte(0) ..databyte(k) is of variable length according to the command code
REQ_RESPONSE may be:
NO_BIN_RESPONSE = 0xa0 (no response requested)
Any other value (response requested)

If one of the databyte(0)..databyte(k) contains 0x2, 0x4 e 0x10, then the databyte must be converted in two bytes accordingly to the following rule (a simple escape sequence to avoid out-of-sync transmissions):
if databyte(n) = 0x2 => converted in => databyte(n) = 0x10; databyte(n+1) = 0x80 + 0x02;
if databyte(n) = 0x4 => converted in => databyte(n) = 0x10; databyte(n+1) = 0x80 + 0x04;
if databyte(n) = 0x10 => converted in => databyte(n) = 0x10; databyte(n+1) = 0x80 + 0x10;

**Table 11.1: Binary commands**

| Command | | | |
|---|---|---|---|
| **CFSA** | | Response | |
| bin_cmd[0] | STX | resp[0] | STX |
| bin_cmd[1] | BIN_CFSA_CMD | resp[1] | BIN_CFSA_CMD |
| bin_cmd[2] | F | resp[2] | Q |
| bin_cmd[3] | N | resp[3] | X |
| bin_cmd[4] | A | resp[4] | (DATA & 0xFF) |
| bin_cmd[5] | (DATA & 0xFF) | resp[5] | ((DATA >> 8) & 0xFF) |
| bin_cmd[6] | ((DATA >> 8) & 0xFF) | resp[6] | ((DATA >> 16) & 0xFF) |
| bin_cmd[7] | ((DATA >> 16) & 0xFF) | resp[7 + delta] | ETX |
| bin_cmd[8 + delta] | RESPONSE | | |
| bin_cmd[9 + delta] | ETX | | |

| Command | | | |
|---|---|---|---|
| **CSSA** | | Response | |
| bin_cmd[0] | STX | resp[0] | STX |
| bin_cmd[1] | BIN_CSSA_CMD | resp[1] | BIN_CSSA_CMD |
| bin_cmd[2] | F | resp[2] | Q |
| bin_cmd[3] | N | resp[3] | X |
| bin_cmd[4] | A | resp[4] | (DATA & 0xFF) |
| bin_cmd[5] | (DATA & 0xFF) | resp[5] | ((DATA >> 8) & 0xFF) |
| bin_cmd[6] | ((DATA >> 8) & 0xFF) | resp[6 + delta] | ETX |
| bin_cmd[7 + delta] | RESPONSE | | |
| bin_cmd[8 + delta] | ETX | | |

| Command | | | |
|---|---|---|---|
| **CCCZ** | | Response | |
| bin_cmd[0] | STX | resp[0] | STX |
| bin_cmd[1] | BIN_CCCZ_CMD | resp[1] | BIN_CCCZ_CMD |
| bin_cmd[2] | RESPONSE | resp[2] | ETX |
| bin_cmd[3] | ETX | | |

| Command | | | |
|---|---|---|---|
| **CCCC** | | Response | |
| bin_cmd[0] | STX | resp[0] | STX |
| bin_cmd[1] | BIN_CCCC_CMD | resp[1] | BIN_CCCC_CMD |
| bin_cmd[2] | RESPONSE | resp[2] | ETX |
| bin_cmd[3] | ETX | | |

| Command | | | |
|---|---|---|---|
| **CCCI** | | Response | |
| bin_cmd[0] | STX | resp[0] | STX |
| bin_cmd[1] | BIN_CCCI_CMD | resp[1] | BIN_CCCI_CMD |
| bin_cmd[2] | DATA_IN | resp[2] | ETX |
| bin_cmd[3] | RESPONSE | | |
| bin_cmd[4] | ETX | | |

| Command | | | |
|---|---|---|---|
| **CTCI** | | Response | |
| bin_cmd[0] | STX | resp[0] | STX |
| bin_cmd[1] | BIN_CTCI_CMD | resp[1] | BIN_CTCI_CMD |
| bin_cmd[2] | ETX | resp[2] | test_res |
| | | resp[3] | ETX |

| Command | | | |
|---|---|---|---|
| **CTLM** | | Response | |
| bin_cmd[0] | STX | resp[0] | STX |
| bin_cmd[1] | BIN_CTLM_CMD | resp[1] | BIN_CTLM_CMD |
| bin_cmd[2] | slot | resp[2] | test_res |
| bin_cmd[3 + delta] | ETX | resp[3] | ETX |

| Command | | | |
|---|---|---|---|
| **CCLWT** | | Response | |
| bin_cmd[0] | STX | resp[0] | STX |
| bin_cmd[1] | BIN_CCLWT_CMD | resp[1] | BIN_CCLWT_CMD |
| bin_cmd[2] | slot | resp[2] | ETX |
| bin_cmd[3 + delta] | ETX | | |

| Command | | | |
|---|---|---|---|
| **CTSTAT** | | Response | |
| bin_cmd[0] | STX | resp[0] | STX |
| bin_cmd[1] | BIN_CTSTAT_CMD | resp[1] | BIN_CTSTAT_CMD |
| bin_cmd[2] | ETX | resp[2] | Q |
| | | resp[3] | X |
| | | resp[4] | ETX |

| Command | | | |
|---|---|---|---|
| **CLMR** | | Response | |
| bin_cmd[0] | STX | resp[0] | STX |
| bin_cmd[1] | BIN_CLMR_CMD | resp[1] | BIN_CLMR_CMD |
| bin_cmd[2] | ETX | resp[2] | (reg & 0xFF) |
| | | resp[3] | ((reg >> 8) & 0xFF) |
| | | resp[4] | ((reg >> 16) & 0xFF) |
| | | resp[5] | ((reg >> 24) & 0xFF) |
| | | resp[6+delta] | ETX |

| Command | | | |
|---|---|---|---|
| **CSCAN** | | Response | |
| bin_cmd[0] | STX | resp[0] | STX |
| bin_cmd[1] | BIN_CSCAN_CMD | resp[1] | BIN_CSCAN_CMD |
| bin_cmd[2] | ETX | resp[2] | (bitmask & 0xFF) |
| | | resp[3] | ((bitmask >> 8) & 0xFF) |
| | | resp[4] | ((bitmask >> 16) & 0xFF) |
| | | resp[5] | ((bitmask >> 24) & 0xFF) |
| | | resp[6+delta] | ETX |

| Command | | | |
|---|---|---|---|
| **LACK** | | Response | |
| bin_cmd[0] | STX | resp[0] | STX |
| bin_cmd[1] | BIN_LACK_CMD | resp[1] | BIN_LACK_CMD |
| bin_cmd[2] | RESPONSE | resp[2] | ETX |
| bin_cmd[3] | ETX | | |

| Command | | | |
|---|---|---|---|
| **NIM_SETOUTS** | | Response | |
| bin_cmd[0] | STX | resp[0] | STX |
| bin_cmd[1] | BIN_NIM_SETOUTS_CMD | resp[1] | BIN_NIM_SETOUTS_CMD |
| bin_cmd[2] | nimo | resp[2] | ETX |
| bin_cmd[3] | value | | |
| bin_cmd[4 + delta] | RESPONSE | | |
| bin_cmd[5 + delta] | ETX | | |

The server response to a non-existing command is the following:
resp[0] = STX;
resp[1] = CMD_ERROR = 0xCE;
resp[2] = ETX;
If the command has the wring number of parameters, or the wrong length, the server response is the following:
resp[0] = STX;
resp[1] = PAR_ERROR = 0xCF;
resp[2] = ETX;

# 12. Board Specifications

**Table 12.1: Mod. C111C Specifications**

| | |
|---|---|
| **Power Supply** | |
| Required voltages on crate | +24 V (100 mA)<br>- 24 V (100 mA)<br>- 6 V (100 mA)<br>+ 6 V (700 mA) |
| **Ethernet interface** | |
| Settings | 10/100 Mbit autonegotiating |
| Default configuration | **IP address**: 192.168.0.98<br>**subnet mask**: 255.255.255.0<br>**default gateway**: 0.0.0.0<br>**DHCP client**: 0 (disabled)<br>(default configuration can be changed through serial port) |
| **Serial port** | |
| Settings | 38400 baud, 8-N-1, no flow control |
| Function | for configuration changes:<br>- system settings<br>- startup options |
| **CAMAC bus interface** | |
| Compliance | to ANSI-IEEE std. 583-1982 |
| **NIM interface** | |
| Connectors | SUHNER type |
| **CPU section** | |
| Processor | ARM7TDMI running at 44 MHz |
| Operating System | uClinux ver. 2.4.17 |
| FLASH | 4 Mbytes |
| SDRAM | 16 Mbytes |