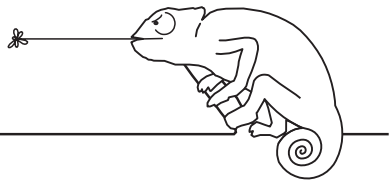
Kameleon® 376 SBC



USER MANUAL

Version 1.0

K-Team S.A.

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Trademark Acknowledgements

IBM PC: International Business Machines Corp.
Macintosh: Apple Corp.
SUN Sparc-Station: SUN Microsystems Corp.
LabVIEW: National Instruments Corp.
Kameleon, Khepera: K-Team

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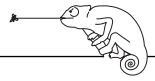
1 INTRODUCTION



The Kameleon 376 Single Board Computer is a very flexible and modular computer board. The hardware modularity is obtained with a very open architecture and several extension possibilities. The onboard software (BIOS and communication tools) is based on the same modular strategy, opening to the user a large field of applications.

To use in the most comfortable way the Kameleon 376 SBC, LabVIEW® and MATLAB® are proposed as a development environment. LabVIEW® is a graphical programming software, basically dedicated to instrumentation, which allows quick development of input-output interfaces, a necessity when dealing with the real world, by definition unpredictable and noisy. MATLAB® is more oriented to scientific analysis and complex computation but requires to know its own programming language.

Please note that LabVIEW® and MATLAB® are just a suggestion and are absolutely not needed to use the board. Any other environment able to deal with the serial port of your computer can be use instead of LabVIEW® or MATLAB®. The communication protocol implemented on the Kameleon board and used by LabVIEW® or MATLAB® is presented in chapter 6 and described in detail in appendix A.

1.1 How to Use this Manual

This manual is organised into six chapters and one appendix. To learn how to make the best use of your Kameleon board you are urged to read all of chapters 1 through 5. Chapter 6 presents the serial communication protocol that makes a remote control from a workstation possible. You need to read the chapter 7 if you want to use the software LabVIEW® and the chapter 8 if you want to use the software MATLAB®. The appendix can be referred to as necessary.

Chapter 1	Gives an introduction to this manual and the Kameleon 376 single computer board.
Chapter 2	explains the contents of the package.
Chapter 3	explains the functionality of every item present in the package.
Chapter 4	explains how to make the first test of the board after unpacking.
Chapter 5	gives the standard working configurations.
Chapter 6	presents the serial communication protocol.
Chapter 7	is addressed to the users of LabVIEW®. It shows simple virtual instruments (VI) to control the board functionality and a little example of programming in this environment.
Chapter 8	is addressed to the users of MATLAB®. It illustrates some commands to control the board functionality and some examples of more complex functionnalities.

Appendix A	details the commands of the serial communication protocol.
Appendix B	details the connectors pinning.
Appendix C	details how to download code on the board
Appendix D	gives some detail on the configuration of some common terminal emulators.
Appendix E	give some common running modes switch setup.

1.2 Safety Precautions

Check the power supply operating voltage before operation.
If you use a power supply not provided by K-Team, check that your power supply has a voltage identical with that of this documentation.

Don't plug or unplug any connector when the system is switched ON.
All connections (including extension addition or disconnection) must be made when the board and the interface are switched OFF. Otherwise damages can occur.

Switch OFF the board if you will not use it for more than a day.
Disconnect the power supply removing the connector from the board or switching off the power supply.

Do not separate the single boards (upper from lower part) if you do not have been explicitly allowed.
Disconnect the CPU to the extension board only if you have been allowed by a specific documentation. Perform this operation following carefully the instructions given in appendix C.

Be very carefully by adding self-developed boards.
When developing your own extensions to the Kameleon board, be careful in testing them on the Kameleon board. K-Team can assume no responsibility for any damage in your concept, schematics, hardware implementation, manipulations or software. Standard electronic know-how is needed for such operations.

Be very carefully by adding electro-mechanical devices.
Also in this case, be careful in adding them on the Kameleon board. K-Team can assume no responsibility for any damage in your concept, schematics, hardware implementation, manipulations or software.

K-Team can assume no responsibility for the use of the Kameleon in specific applications in any field, including robotics.

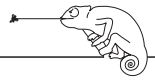
If you have any question or problem concerning the board, please contact your Kameleon dealer.

1.3 Recycling

Think about the end of life of your board and of the accessories! Parts of them can be recycled and it is important to do so. It is for instance important to keep Ni-Cd batteries out of the solid waste stream. When you throw away a Ni-Cd battery, it eventually ends up in a landfill or municipal incinerator. These batteries, which contain heavy metals, can contribute to the toxicity levels of landfills or incinerator ash. By recycling the Ni-Cd batteries through recycling programs, you can help to create a cleaner and safer environment for generations to come. For those reasons please take care to the recycling of your board at the end of its life cycle, for instance sending back the board and accessories to the manufacturer or to your local dealer.

Thanks for your contribution to a cleaner environment!

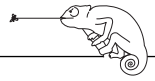
2 UNPACKING AND INSPECTION



Open the package and identify the following items:

1. The documentation you are reading now
2. Power supply cables
3. Spare parts: jumpers and fuses
4. Your Kameleon board in the basic version

3 THE BOARD AND ITS ACCESSORIES



3.1 The Kameleon 376 SBC

3.1.1 Overview

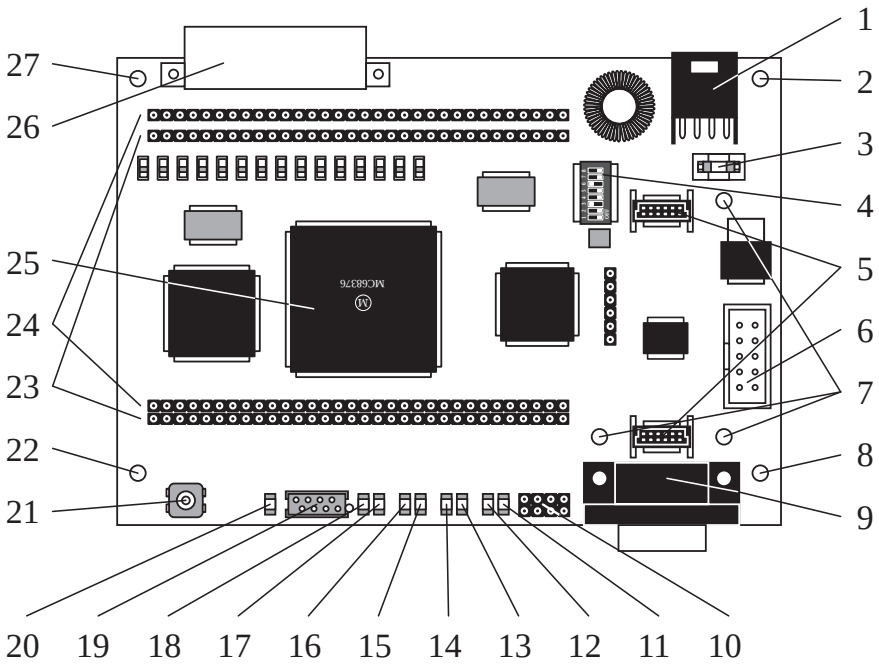


Figure 1: Position of some parts of the board.

Make an external inspection of the board. Note the location of the following parts:

1. Power supply connector.
2. Board fixation hole.
3. Main power fuse.
4. Running mode selector.
5. SXB (Serial eXtension Bus) extension connectors.
6. BDM connector.
7. SXB extension fixation supports.
8. Board fixation hole.
9. Primary RS232 connector.
10. Kameleon basic configuration jumpers.
11. RS232 Tx (transmit) green LED.
12. RS232 Rx (receive) red LED.
13. User 0 LED. Can be used by the user.
14. User 1 LED. Can be used by the user.

15. User 2 LED. Can be used by the user.
16. User 3 LED. Can be used by the user.
17. User 4 LED. Normally used by the alive process. Can be used by the user removing the alive process.
18. Power supply LED. Is ON when the system has power supply.
19. K-Net local network connector (Khepera compatible network).
20. K-Net activity LED.
21. Reset button.
22. Board fixation hole.
23. CXB (CPU eXtension Bus) connector.
24. IXB (Interface eXtension Bus) connector.
25. Kameleon CPU.
26. MMA extension connector.
27. Board fixation hole.

3.1.2 Mechanical support

The Kameleon board has to be mounted using the four fixation holes (items 2, 8, 22 and 27 of figure 1). These holes are made for a fixation with M3 screws (3mm in diameter) and are placed on a grid having a step of 15 mm. The MMA extension connector cannot be used as mechanical support of the board.

To stack several Kameleon boards, please plan to fix them by mean of stand-offs (board spacers).

3.1.3 Power supply and main fuse

The Kameleon board accepts a main DC power supply having a voltage between 8.5V and 20V. This voltage has to be applied on the power supply connector between V+ and V-. The same connector deliver a 5V logic power supply output. The logic ground and the power ground (V-) are connected on the board.

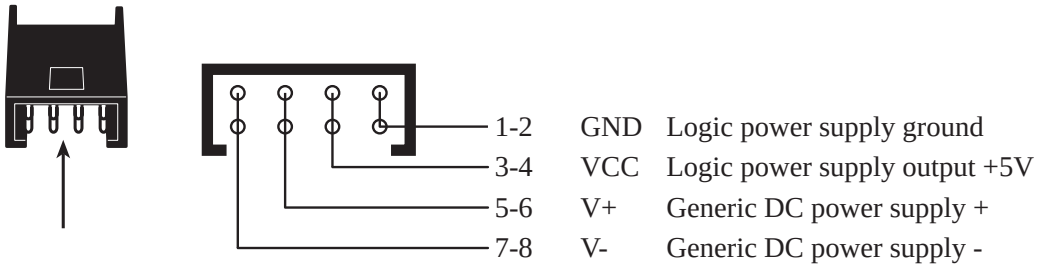


Figure 2: Power supply connector.

The Kameleon board has no main ON_OFF switch.

A fuse protects the Kameleon board against major problems. The fuse is placed

near to the main power connector as illustrated in figure 3. The fuse current limitation is 1A, temporized.

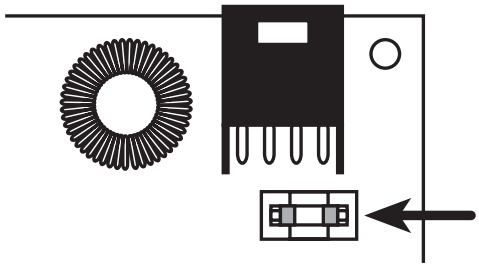


Figure 3: Fuse location.

3.1.4 Basic configuration jumpers

A grid of 2x4 jumpers holes (item 10 in figure 1) is placed near the RS232 connector.

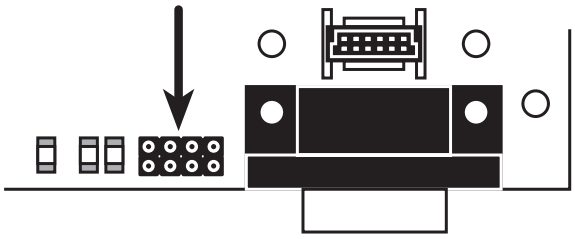
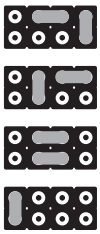


Figure 4: Basic configuration jumpers location.

The jumpers configuration define several basic functionnalities of the Kameleon board. Some example are given in figure 5. For more details please consult the schematics of the board.



Default configuration: boot on FLASH, /AVEC on extension bus

boot on extension bus, /CSExt4 on FLASH

boot on FLASH, /CSExt4 on extension bus

8 bit boot mode

Figure 5: Examples of basic jumper configuration.

3.1.5 Running modes

The running mode of the board is defined by a DIP switch (item 4 in figure 1) and defines the software executed at boot by the Kameleon board.

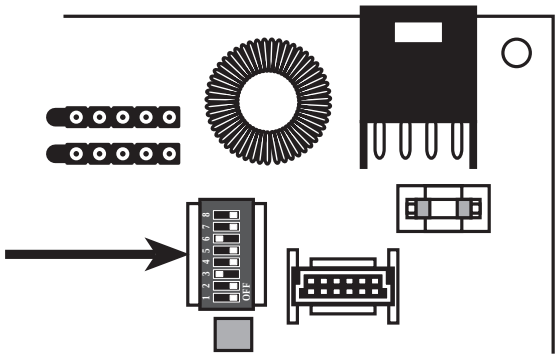


Figure 6: Position of the DIP-switch running mode selector.

The software installed on your board includes an important library of modules for the real time control of the Kameleon board. Part of these modules (building the BIOS) ensure the basic functionnalities of the Kameleon board, like hardware configuration, bus recognition, extensions setup etc. Another part of these modules ensure the interface with the user through the serial line or another communication channel. Depending on the use of the Kameleon (remote control, downloading, test, etc.) you can specify the boot on a given software module by setting the correspondent running mode. Three switches (positions 1, 2 and 3) of the running mode selector (item 4 of figure 1) allow the selection of the most important running modes in several configurations. You have the choice between the following switch configurations (see figure 7 for the corresponding switch positions):

0. Reserved.
1. User FLASH application execution. Starts the program stored by the user in FLASH memory. Default serial line speed is 38400 Baud.
2. Start the SerCom mode on the MMA as communication channel.
3. Reserved.
4. Reserved.
5. Start the SerCom mode on the RS232 as communication channel. Default serial line speed is 38400 Baud.
6. Reserved.
7. Download mode to recharge the full Kameleon system. **WARNING: this operation erase the system! Be sure to have a new one to download!**

The serial link set-up is always 8 bit, 1 start bit, 2 stop bit, no parity. Only the baud rate changes.

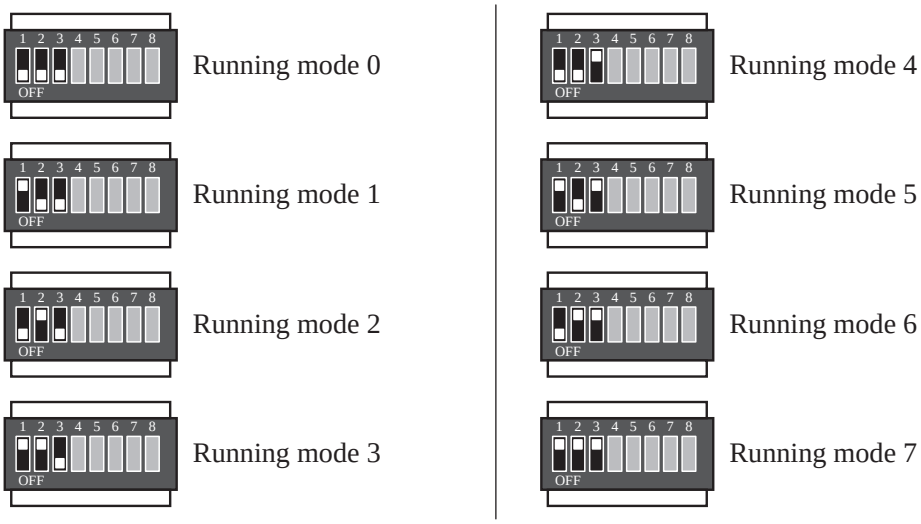


Figure 7: DIP-switch running mode setting for positions 1, 2 and 3.

The switch 4 of the running mode selector (item 4 of figure 1) defines if the board acts on the MMA bus as slave or as master. If set on the OFF position, the board is a MMA master.If set on the ON position, the board is a MMA slave. This setting is useful only with multiple-boards configurations or when using the Kameleon board as Koala extension board.

The switch 5 of the running mode selector defines if the MMA extension connector is used as MMA communication port or as MUBUS extension connector. If set on the OFF position, the connector is a MMA port.If set on the ON position, the connector is a MUBUS interface.

Two switches (positions 6 and 7) of the running mode selector define the MMA slave ID if the board is configured as MMA slave.

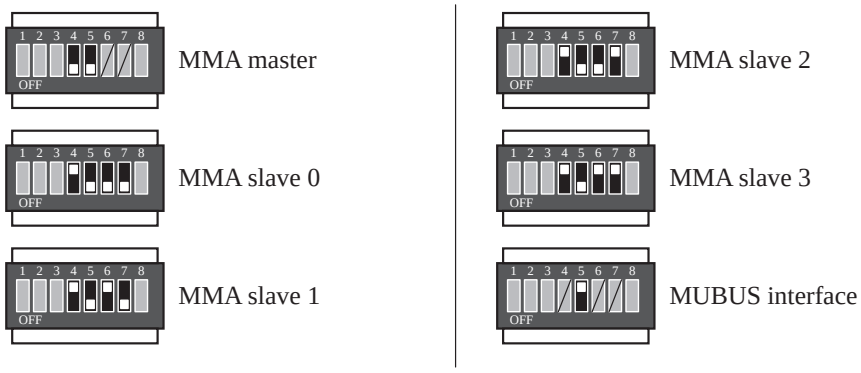


Figure 8: DIP-switch running mode setting for positions 4, 5, 6 and 7.

The switch in position 8 defines if the MUBUS bus available on the MMA connector (see “The MMA extension connector” on page 10) has the 5V power supply or not. If set in the ON position, the MUBUS bus has a 5V power supply. If set in the OFF position, MUBUS has no 5V power supply and extensions can be powered externally.

The set-up of the switches can be changed at any time. **If the board is running, it is necessary to make a reset to make the set-up effective.**

3.1.6 Reset

The reset button (item 21 of figure 1) can be used at any time to reset the board. Please reset the board using this button and not switching off and on the board.

3.1.7 LEDs

The board is equipped with 9 LED (items 11 to18 and 19 of figure 1) of different colours and having various functions.

The two LEDs (items 11 and 12 of figure 1) placed near the RS232 9 pin connector show the RS232 serial communication activity. The first LED (item 11 of figure 1) which is green, indicates the data going from the Kameleon board to external devices. It is called Tx (transmit) data LED. The second LED (item 12 of figure 1) which is red, indicates the data coming from an external device to the Kameleon board. It is called Rx (receive) data LED.

The 5 LEDs (items 13 to 17 of figure 1) situated after the RS232 Rx and Tx LEDs are user specific LEDs, numbered from 0 to 4. User specific means that these LEDs have no fixed and specific meaning for the basic functionnalities of the board and can be activated by the user to display user specific information. The last LED (item 17 of figure 1) is not completely free. The user can access to it but this LED is normally used by the ALIVE process. When this process runs, the LED is switched on and off continuously, showing that the processor and the board are alive. As soon as this LED stop flashing, there could be a problem at the level of the processor. This functionality is normally appreciated by the user, which often implement this type of background tasks. For this reason this LED is included in the user specific LEDs.

The last LED (item 18 of figure 1) before the K-net connector is the power supply LED, active when the board is powered.

The LED placed after the K-net connector shows the K-net activity. Please refer to the section on the K-net (“The K-Net extension connector” on page 10) for more details.

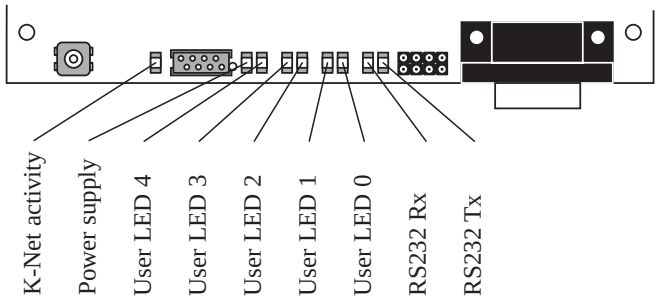


Figure 9: LEDs positioning and functions

3.1.8 The RS232 connector

The 9 pin DB9 connector (item 9 of figure 1) enable a primary RS232 connection with the Kameleon board. This RS232 interface is configured as DCE and can therefore be connected directly to a computer. No null-modem is needed to connect the Kameleon board to a computer. A null-modem cable is needed for the connection of the Kameleon board with another DCE device, like a modem for instance.

This primary RS232 connection is used for all messages of boot and interaction with the user equipped with a terminal or a higher level interface (LabVIEW or MATLAB, for instance).

A secondary RS232 connection can be obtained equipping the Kameleon board with an extension board on the SXB connectors (item 5 of figure 1).

3.1.9 The BDM connector

The Kameleon board is equipped with a BDM connector (item 6 of figure 1) which enable the access to the Background Debug Mode of the microcontroller. This hardware feature of the CPU32 core of the Motorola microcontroller enable to make very low-level debug on the code running in the microcontroller. Please refer to the Motorola documentation [Motorola98] for more details.

3.1.10 The K-Net extension connector

The K-Net network is a Khepera compatible serial communication network for multi-processors systems.

On the Khepera robot, this bus is used for the communication between the extension turret processors and the main Khepera processor. The main Khepera processor is considered as master on the network, all other processors as slave. Each slave has its own identification number which is unique on the network. The communications are always initiated by the master and slaves answer only to master requests. At boot, the master scan the K-Net bus to identify all extensions placed on it and download from each of them the specification of the turret. This gives to the system and to the user the possibility to know exactly the number and configuration of the extensions.

On the Kameleon board, this bus can be used to connect Khepera turrets or other devices equipped with the K-Net bus.

3.1.11 The MMA extension connector

As for the K-Net (see “The K-Net extension connector” on page 10), the MMA (Multi Microcontroller Adapter) extension bus is used for inter-processor communications. Compared to the K-Net, the MMA bus is much faster because not serial but parallel.

The communication on the MMA bus is based on FIFO memories associated with specific electronics for interrupt generation on the destination processor and FIFO mem-

ory management. As on the K-Net, devices on the bus can be master or slave. The communication is always initiated by the master. The slave only answers to master requests. Messages are placed into the FIFO memory and an interrupt is generated on the destination device as soon as the message is completely inside the FIFO memory. The destination device reads the FIFO content and, in the case of the slave receiving a command, answers to this command in the same way, putting the answer message inside the FIFO going in the opposite direction and generating an interrupt on the destination processor.

Depending on the running mode configuration (see “Running modes” on page 6) the MMA connector can be reconfigured to implement a MUBUS connector. MUBUS is a simple 8 bit processor bus equipped with some address lines, chip-select and read/write signals. Please consult the technical description [K-Team99] for more details.

3.1.12 The SXB extension connector

The Kameleon board is an open system with several extension possibilities. One of this possibilities is available using the Serial eXtension Bus (SXB) connector (item 5 in figure 1), which enable addition of communication channels. Optional modules can be plugged on this connector to implement a second RS232 line or to access to a CAN bus.

SXB extension boards have to be fixed on the SXB fixation supports.

3.1.13 The CXB and IXB extension connectors

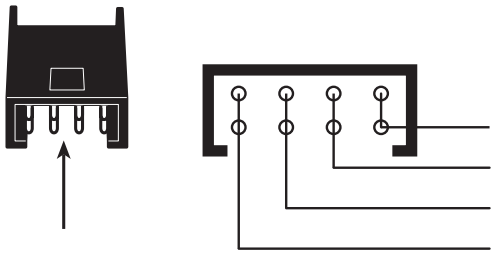
The Kameleon board application specific functionnalities can be drastically extended by two piggy-back connectors: the CXB (CPU eXtension Bus) and the IXB (Interface eXtension Bus) connectors.

The CXB extension connector (item 23 of figure 1) support mainly CPU bus signals like data addresses, chip-select etc.

The IXB extension connector (item 24 of figure 1) support mainly signals coming from the peripherical modules of the Motorola 68376 microcontroller like analog inputs, timer signals, TPU lines etc.

3.2 Cables and accessories

The power supply cables allows the connection between the Kameleon board and a power supply or a battery pack. Please consider that black wires have to be connected to GND, blue wires to the positive pole (between 8.5V and 20V).



1-2	GND	Logic power supply ground
3-4	VCC	Logic power supply output +5V
5-6	V+	Generic DC power supply +
7-8	V-	Generic DC power supply -

Figure 10: Power supply connector.

Two spare fuses (to replace item 3 of figure 1) are also included in the package.

For any other accessory you would need to use the Kameleon board, please contact your Kameleon distributor.

3.3 External power supply

A DC power supply or batteries can be used to power the Kameleon board. The input voltage have to be between 8.5V and 20V. A switching converter is present on the Kameleon board and ensures the 5V generation.Typical power consumption is 180mA under 12V DC.

SAFETY PRECAUTION: The power supply must be provided to the Kameleon board only when all other connections are already made.

3.4 Software

Software is available from the K-Team WEB server under:

http://www.k-team.com/download/

Please check this page for LabVIEW, MATLAB or Mathematica modules as well as compilers. This page also include software and documentation updates.

3.5 Extension possibilities

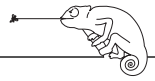
The Kameleon board can be extended in several ways:

- Adding a communication board on the SXB connectors (see “The SXB extension connector” on page 11).
- Adding devices on a bus managed by a SXB extension. An example is the CAN bus, which can be added to the Kameleon board using an SXB board and which enables to connect sensors, actuators and other boards to the Kameleon board.
- Adding an application specific electronics on the CXB or on the IXB or on both extension connectors (see “The CXB and IXB extension connectors” on page 11).
- Adding a Khepera compatible extension turret on the K-Net connector (see

"The K-Net extension connector" on page 10).

- Adding a MMA device on the MMA connector (see "The MMA extension connector" on page 10). On the MMA bus, the Kameleon board can be configured as master or as slave. In this way, several Kameleon boards can be combined to build a multiprocessor system.
- Adding devices on the MUBUS bus which can be obtained by a particular configuration of the MMA bus connector (see "Running modes" on page 6).

4 UNPACKING TEST



After unpacking it is important to test the basic functionality of the Kameleon board. Several of these functionnalities can be checked at boot looking to the LEDs available on the board. To observe the LEDs activation please operate as following:

- Verify that the Kameleon board is set in the running mode 5 (see "Running modes" on page 6).

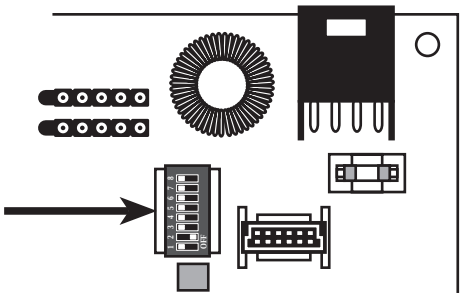


Figure 11: Settings of the jumpers for the running mode 5.

- Power supply the Kameleon board.

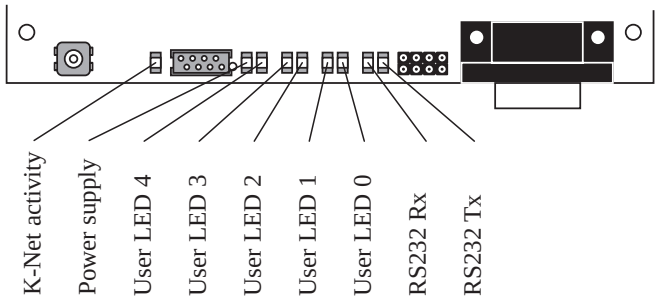


Figure 12: LEDs positioning and functions

The LEDs should have the following activation:

- First of all, the power supply LED should become active
- Then, the K-Net activity should blink shortly. This correspond to the auto-

configuration test of the K-Net network.

- Just after the K-Net activity, the RS232 Tx (transmit) LED should blink, showing that the Kameleon board is started in mode 5 and send the welcome message.
- At the same moment, the ALIVE LED (User LED 4) should start blinking in a regular way. This shows that the processor has a process running in it.

5 CONNECTIONS

There are two main standard connection: a first one to stack Kameleon boards and enable the communication on the MMA bus and a second one that allows the communication between the Kameleon board and the host computer.

5.1 MMA interconnection

Warning: It is necessary to make all connection with the board power supply switched OFF or the batteries disconnected. Making connection with a powered board can cause damages.

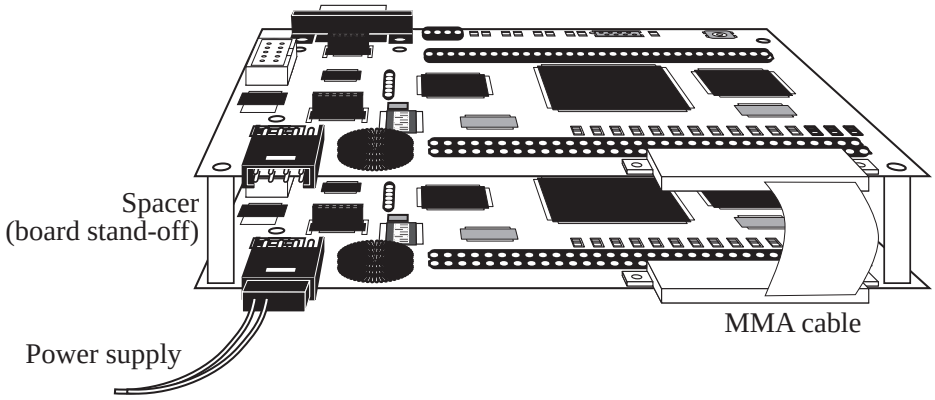


Figure 13: Connections to stack several Kameleon boards.

To ensure the functionality of several Kameleon boards, please do the following connections:

- Stack the Kameleon boards using spacers (board stand-offs).
- Connect the MMA cable. This cable need to have ONLY the first 26 wires (a1 to a13 and b1 to b13) connected, as shown in figure 13.
- Select the correct running mode in such a way to have only one master board and one or more slave Kameleon boards. Please see “Running modes” on page 6 for more details.
- Power supply ONE of the stacked Kameleon boards. All other boards will be powered by the MMA cable.

5.2 Configuration for Kameleon-computer communication

This configuration allows the communication between the Kameleon board and a host computer through a RS232 serial link. On the host computer side the link is made by a RS232 port.

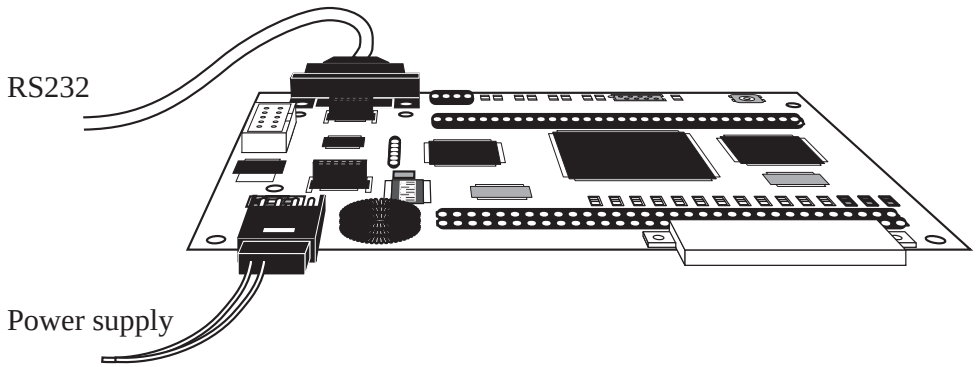


Figure 14: Kameleon-computer communication set-up

The following connections must be made:

- Between the Kameleon board and the host computer using a straight 9 pin RS232 cable.
- Between the Kameleon board and the DC power supply using the cable provided with the Kameleon board (see “Cables and accessories” on page 11)

To test the connection and the settings of the serial port do the following manipulations:

- Verify that the Kameleon board is set in the running mode 5 (see “Running modes” on page 6).

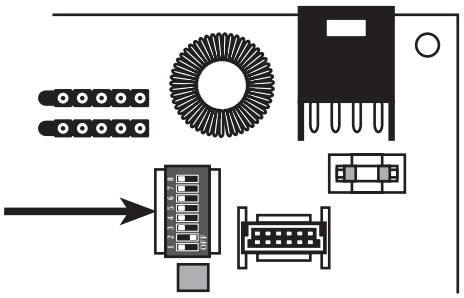


Figure 15: Settings of the jumpers for the running mode 5.

- Run a terminal emulator on your host computer (for instance Hyper Terminal on PCs, Z-Term on MACs, tip on UNIX or minicom on linux, see “RS232 configuration” on page 33) on which you have connected the Kameleon board. **Configure your terminal as following: 38400 Baud, 8 bit, 1 start bit, 2 stop bit, no parity.**
- Plug the mural power supply to the main, or, if it is already connected,

reset the Kameleon board pressing on the reset button.

Your terminal should display:

```
ROM of K376SBC board,...
```

The transmit data (RS232 Tx, item 11 on figure 1) green LED should blink after reset. If the Kameleon board does not respond as indicated (the green Tx LED does not blink after reset), check the points mentioned above and retry. If the green LED blinks but your computer does not show any message, check the configuration of your serial port and terminal emulator, as well as the connection between Kameleon board and host computer.

6 THE SERIAL COMMUNICATION PROTOCOL

The serial communication protocol allows the complete control of the functionnalities of the Kameleon board through an RS232 serial line. It correspond to running mode 5 (see “Running modes” on page 6). The connection configuration necessary to use these functionnalities is presented in the section 5.2 of this manual. The configuration (baudrate as well as data, start, stop and parity bits) of the serial line of your host computer must correspond to the one set on the Kameleon board with the jumpers (running mode 5, 38400 Baud, 8 bit, 1 start bit, 2 stop bit, no parity).

The communication between the host computer and the Kameleon board is made sending and receiving ASCII messages. Every interaction is composed by:

- A command, sent by the host computer to the Kameleon board and followed by a carriage return or a line feed.
- When needed, a response, sent by the Kameleon to the host computer.

In all communications the host computer plays the role of master and the Kameleon board the role of slave. All communications are initiated by the master.

The communication is based on two types of interactions: one type of interaction for the set-up of the board (for instance to set the running modes, the transmission baudrate...), and one type of interaction for the control of the functionality of the board (for instance to set LEDs state, read analog inputs...). The interactions allowing the set-up of the board are based on commands called *tools*. The interactions for the control of the board functionality uses *protocol* commands and responses.

6.1 The tools

Here is the description of some basic tools:

“run” Starts a function stored in the FLASH. It has to be followed by the function name. The functions available in the FLASH can be listed with the *list* tool and have an identification string beginning with “FU”. Some of the functions corre-

spond to the running modes presented in the section 3.1.5. Using the *run* tool it is possible, for instance, to start the user FLASH mode (corresponding to the running mode 1, as described in section 3.1.5) typing “run user-flash” and return.

“serial” Sets the serial channel to a baud-rate, given as parameter. For instance, typing “serial 19200” and return you set the baudrate to 19200 Baud.

“help” Shows the help message of the modules available in the FLASH. A parameter can be used to indicate a need of help on a particular item. “help list” gives an help message for the *list* tool.

“list” Gives the list of all the tools, functions, protocol commands and other modules available in FLASH. For every item listed you get an ID, a name, a description and a version. The ID is composed by four letters. The first two letters define the family of the module: IDs starting by “TA” define tasks running on the Kameleon, “FU” functions that can be executed with the *run* command, “PR” protocol commands, “TO” tools like this one and “BI” BIOS components.

“k-team” Gives a short description of the K-Team active members.

“net” Gives an information about the intelligent extension turrets installed on the K-Net connector. For each item listed you get a name, an ID (to be used to address the turret, see also the command ‘T’ in appendix A), a description and a revision.

“memory” Gives an information about the memory used by the system.

“restart” Resets the Kameleon board. This action is equivalent to a hardware reset.

“process” Gives the list of all processes running on the Kameleon board in parallel to the serial communication protocol management.

“sfill” Starts a Motorola S format downloader. This downloader does not start the execution of the code at the end of the download. To download and execute a code, please use the sloader function, started by the command “run sloader”.

6.2 The control protocol

To control the functionnalities of the Kameleon board a set of command are implemented in the control protocol. Also in this case, the communication with the Kameleon board is made sending and receiving ASCII messages. Every interaction between host computer and Kameleon is composed by:

- A command, beginning with one or two ASCII capital letters and followed, if necessary, by numerical or literal parameters separated by a comma and

terminated by a carriage return or a line feed, sent by the host computer to the Kameleon board.

- A response, beginning with the same one or two ASCII letters of the command but in lower-case and followed, if necessary, by numerical or literal parameters separated by a comma and terminated by a carriage return and a line feed, sent by the Kameleon board to the host computer.

In all communications the host computer plays the role of master and the Kameleon the role of slave. All communications are initiated by the master.

The protocol commands is described in Appendix A.

6.3 Testing a simple interaction

To better understand both tools and protocol commands, we propose to do a very simple test as following:

- Verify that the Kameleon board is set in the running mode 5 (see “Running modes” on page 6).

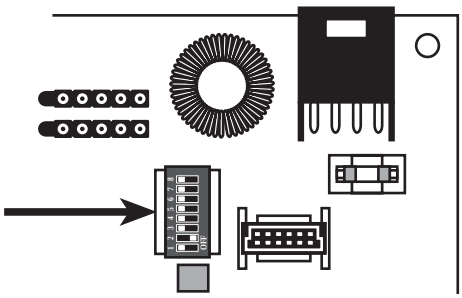


Figure 16: Settings of the jumpers for the running mode 5.

- Set the connection configuration presented in section 5.2.
- Start on your host computer a terminal emulator (for instance Hyper Terminal on PCs, Z-Term on MACs, tip on UNIX or minicom on linux, see “RS232 configuration” on page 33) with the serial line set to 38400 Baud, 8 bit data, 1 start bit, 2 stop bit, no parity.

We start testing some tools:

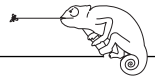
- Type the command **help** followed by a carriage return or a line feed.
- The Kameleon board must respond with the list of all tools available.
- Type the command **help serial** followed by a carriage return or a line feed.
- The Kameleon board must respond with the description of the “serial” tool.
- Type the command **help I** followed by a carriage return or a line feed.
- The Kameleon board must respond with the description of the “I” protocol command.

- Type the command **list** followed by a carriage return or a line feed.
- The Kameleon board must respond with the list of all software modules present in the FLASH. In addition to the “tools” (characterised by a “TOXX” ID) and the “protocol” commands (characterised by a “PRXX” ID) you can find on the list “functions” (characterised by a “FUXX” ID) and BIOS modules (characterised by a “BIXX” ID). On every module you can have an help message.

We continue with some protocol commands:

- Type the capital letter **B** followed by a carriage return or a line feed.
- The Kameleon board must respond with **b** followed by an indication of the version of software running on the board and terminated by a line feed.
- Type the capital letter **I,2** followed by a carriage return or a line feed.
- The board must respond with **i** followed by a number separated by a comma and terminated by a line feed. This number represent the voltage present on the second analog channel of the IXB bus (see “The CXB and IXB extension connectors” on page 11) in 4mV units.
- Type the capital letter **I,15** followed by a carriage return or a line feed.
- The board must respond with **i** followed by a number separated by a comma and terminated by a line feed. This number represent the power supply voltage present your Kameleon board in 20mV units.
- Try other commands following the description given in Appendix A.

7 USING LABVIEW®



The goal of this chapter is to familiarise you with the LabVIEW® environment in the context of Kameleon use. LabVIEW® is a product of National Instruments (http://www.natinst.com). To this end, the examples are presented in an increasing order of complexity. Our advice is to follow the chronological order of presentation. Please refer to the LabVIEW manuals for more information about this software.

The following examples and the files available on the K-Team WEB site are based on LabVIEW® version 5.

LabVIEW® runs on your PC, Macintosh® or SUN®, and can control the functionality of the Kameleon board using the serial communication protocol described in section 6.2.

7.1 Hardware configuration

Set your environment as illustrated in section 5.2. The jumpers must be set as showed in figure 17, to obtain the running mode 5 (for more details on running modes please refer to section 3.1.5).

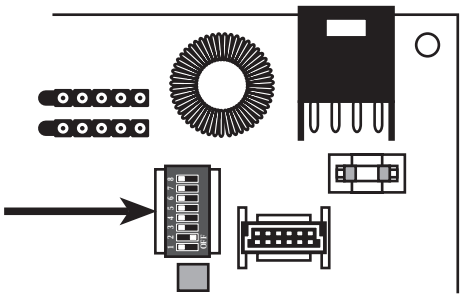


Figure 17: Settings of the jumpers for using LabVIEW ® and a serial connection at 38400 baud.

7.2 Set up of the serial link

To enable the exchange of information between your computer and the board, you have to configure the serial link of your host computer, according to the one you settled on the Kameleon board.

Be sure that the connection cable is connected at both ends (Kameleon and host computer), that the board is powered (DC power supply), then start LabVIEW® and open the Set-up.vi virtual instrument (called “VI”) present in the package.

The panel illustrated in figure 18 should appear.

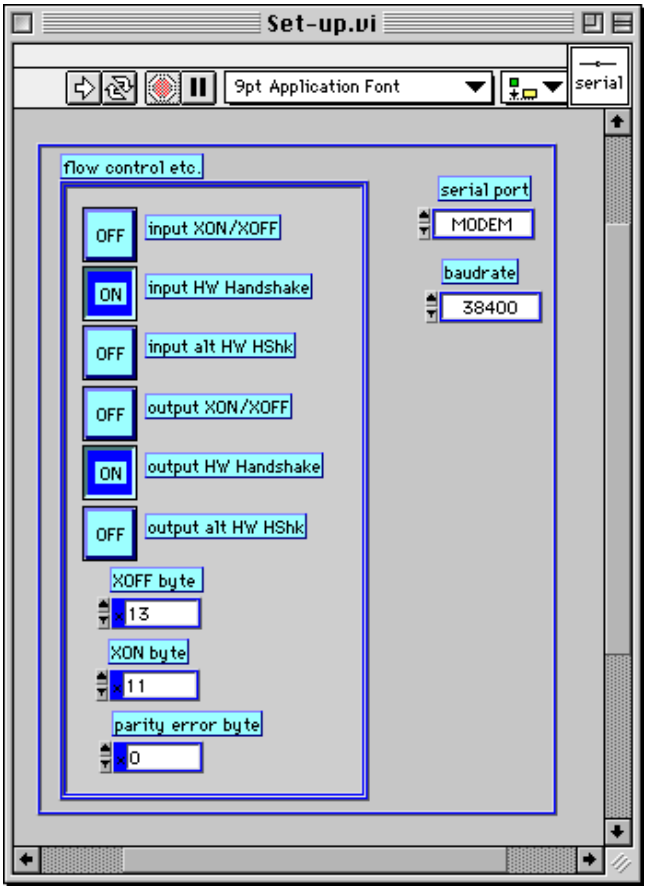


Figure 18: Set up panel for serial link initialisation.

Now, select the serial port on which the board is connected. This selection depend on which port you use and the type of computer you have. This choice must be made for every module that you will use.

Then click once on the run arrow  at the top of the window.

A stop icon  appears for a few seconds, after what the front panel returns to its initial state.

That's all! The serial link with Kameleon is set to 38400 baud. It will remain so until you quit LabVIEW® or you execute the Set-up.vi again.

7.3 Power supply

We will now check the power supply voltage of the board. Be sure that the serial link has been correctly installed, then open the Get_Vin_value.vi present on the package. Now your screen displays the following panel:

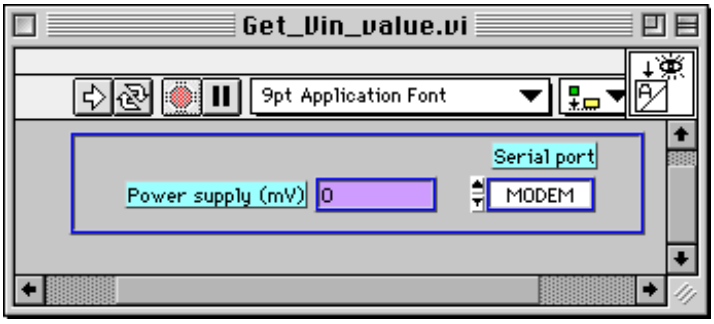


Figure 19: Get_Vin_value panel: one indicator shows the voltage of your power supply.

To read the voltage, just click once on the arrow. You can change the power supply voltage (if you have a laboratory power supply with adjustable voltage) and click on the arrow again to read the value.

If you are getting bored with clicking on the arrow, try one click on the double arrow  . Click on the stop icon to stop the execution.

The board has 14 other analog inputs on the IXB bus (see “The CXB and IXB extension connectors” on page 11). The VI “Get_ana_value.vi” enable to display the analog value present of each analog channel.

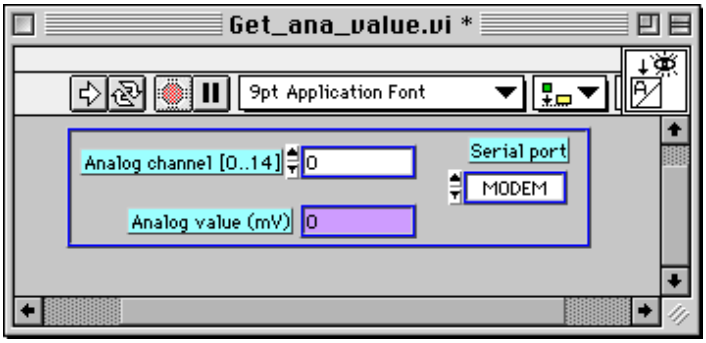


Figure 20: Get_ana_value panel: an indicator shows the voltage on the given channel.

The “Get_version.vi” display the software version you have in your Kameleon.

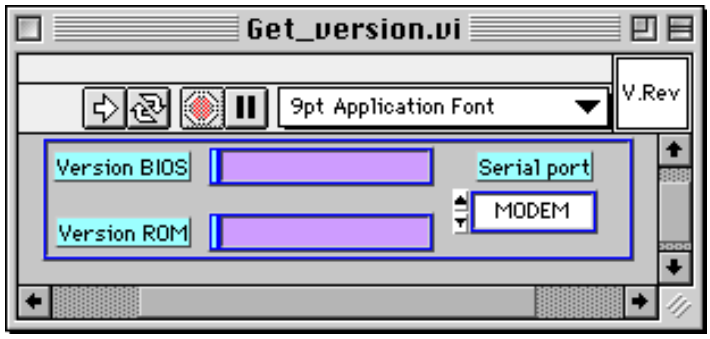


Figure 21: Get_ana_value panel: an indicator shows the voltage on the given channel.

Another VI which has a visible action on the Kameleon board is the Set_LED.vi. This VI enable to control the activity of the 5 user LED (see “LEDs” on page 9). Please remember that LED 4 is used by the ALIVE process and that your action will be combined with the action of the ALIVE process.

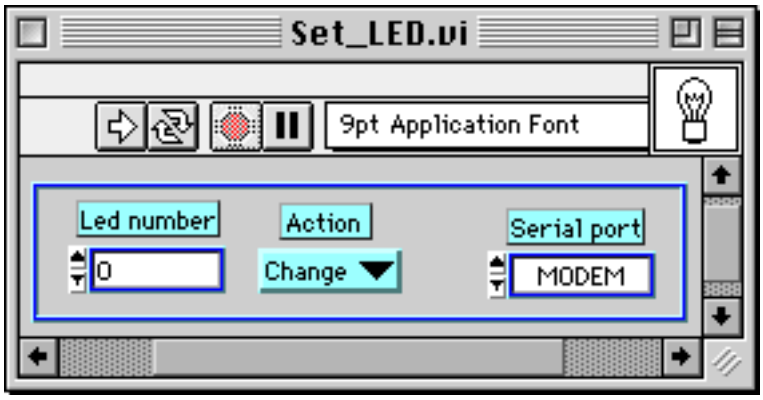


Figure 22: Set_LED panel: both LED number and action can be set.

To use this VI, choose the LED number entering it, and choose the action to perform using the Action menu. Clicking on the run arrow will execute your command.

Several other VIs are available to control the Kameleon functionnalities. There is at least one VI for each command of the SerCom protocol described in Appendix A.

To use all functionnalities and test in details all the SerCom protocol, you can also use K-Terminal.vi. When started, this VI display the panel illustrated in figure 23.

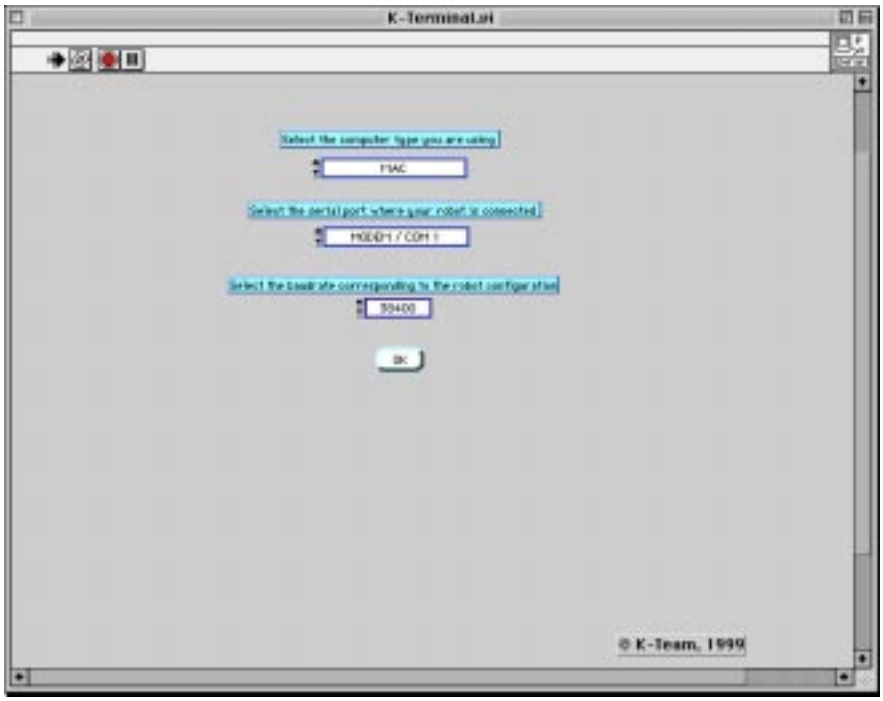


Figure 23: The K-Terminal panel when started: some choices have to be made.

As soon as the K-Terminal is started, please choose the machine you are working on, the serial port where Kameleon is connected as well as the baudrate. Normally you should choose running mode 5 and therefore a baudrate of 38400. Once the settings are chosen, please click on OK, and the panel will change to the layout shown in figure 24.

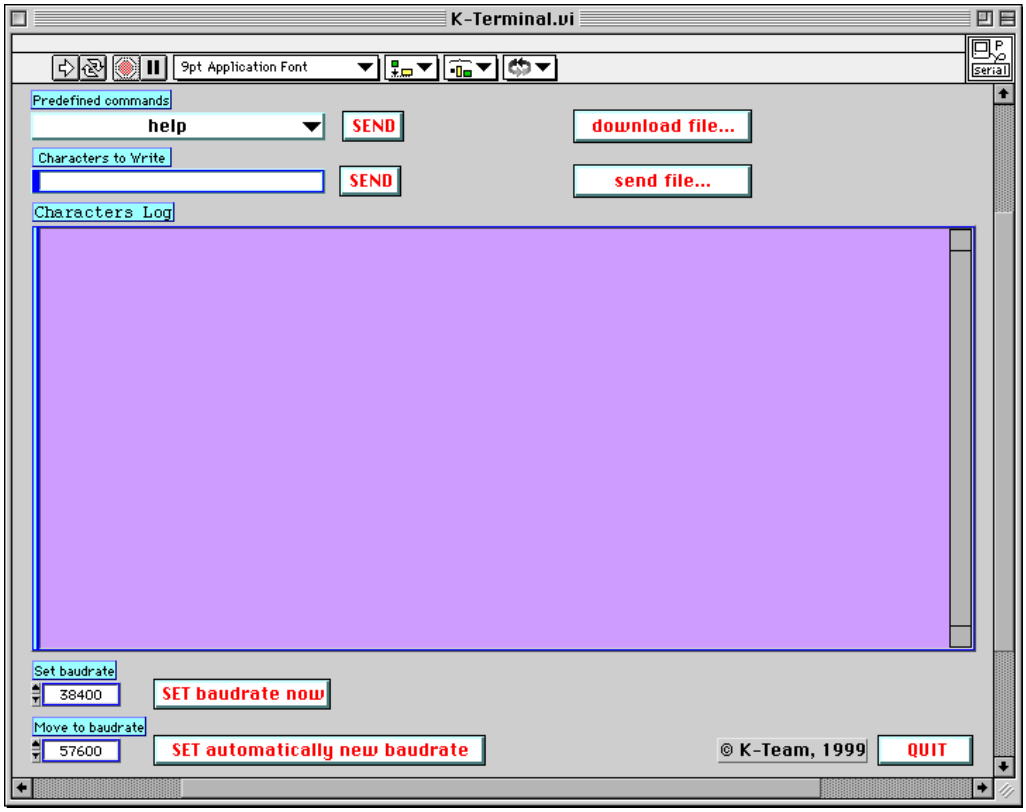


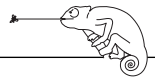
Figure 24: K-Terminal panel.

K-Terminal allows you many possibilities of interaction with your Kameleon board. We will list the main controls and explain their effect:

- The “predefined commands” menu gives you some standard tools. As soon as the tool is chosen, please click on the SEND button to make it effective. The result is given in the main log window.
- More specific commands, like **help memory**, can be entered in “Characters to write” and sent with the corresponding SEND button. The result is also listed in the main log window.
- Two buttons on the top right of the widows allow to download or simply send files to the Kameleon board. The difference between the download and the send operation is in the fact that the download button set the Kameleon board in the “sloader” mode before sending the file. The send button simply send the file without special operations. As soon as a button is activated, a dialog box asks for the file name.
- The “Set baudrate” menu under the main log window make it possible to change the baudrate when the VI is running. To make the menu selection effective, please click on the “SET baudrate” button.

- The “Move to baudrate” menu under the main log window make it possible to change automatically to a new baudrate when the VI is running under the SerCom protocol. This feature is available using the “serial” tool, which enable to change the baudrate by software. To make the menu selection effective, please click on the “SET automatically new baudrate” button. The VI will automatically send a “serial” command to change the baudrate on the Kameleon board and then change the baudrate setup of your computer.
- To quit properly this VI, please use the QUIT button and avoid to stop the VI with the STOP button of the control bar.

8 USING MATLAB®



The goal of this chapter is to familiarise you with the MATLAB® environment in the context of Kameleon use. MATLAB® is a product of The Mathworks Inc. (http://www.mathworks.com/). To this end, the examples are presented in an increasing order of complexity. Our advice is to follow the chronological order of presentation. Please refer to the MATLAB manuals for more information about this software.

The following examples and the files available on the K-Team WEB site are based on MATLAB® version 5.0.

MATLAB® runs on several platforms but K-Team modules are available only for MATLAB® under Windows® and Macintosh®. These modules can control the functionality of the Kameleon board using the serial communication protocol described in section 6.2.

8.1 Hardware configuration

Set your environment as illustrated in section 5.2. The jumpers must be set as showed in figure 25, to obtain the running mode 5 (for more details on running modes please refer to section 3.1.5).

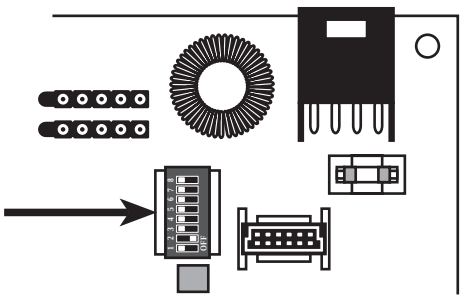


Figure 25: Settings of the jumpers for using MATLAB® and a serial connection at 38400 baud.

8.2 Set up of the serial link

To enable the exchange of information between your computer and the board, you have to configure the serial link of your host computer, according to the one you settled on the Kameleon board.

To install the MATLAB® modules to control the Kameleon board, please download the package from the K-Team WEB site (http://www.k-team.com/download) and follow the README instructions.

Be sure that the connection cable is connected at both ends (Kameleon and host computer), that the board is powered (DC power supply), then start MATLAB® and set the accesses to the K-Team package as indicated in the README file.

To open a serial connection with your Kameleon board you have to use the kopen command as follow:

```
» ref=kopen([0,38400,1])
ref =
1.0e+009 *
0.0000    2.0133    0.0009    0.0386
```

The first parameter of kopen is the serial port. The serial port number 0 correspond to the modem port on MAC and to COM1 on PC. The serial port number 1 correspond to the printer port on MAC and to COM2 on PC. The second parameter is the baudrate. The third parameter is the timeout in seconds. This function returns a ref matrix which will be used for all other communication with your Kameleon board.

Before leaving MATLAB, always close the connection using:

```
» kclose(ref)
```

To send a command string and get a single line answer string from your Kameleon board, please use the “kcmd” command. To get the power supply voltage of the Kameleon board, for instance, do as following:

```
» kcmd(ref,'I,15')
ans =
i,606
```

The first parameter of the “kcmd” command is the reference matrix obtained from the kopen command. The second parameter is the string which has to be sent to the Kameleon board. The answer string (line finished by carriage return and line feed) received before the timeout is returned. In this example, 606 represent the power supply voltage in 20mV units.

For commands which have multi-line answers, “kcmd” has a third parameter. If set to one, this parameter enable to get all characters until the timeout. Please adjust the timeout in order to ensure a correct transmission. For instance you can try the following command:

```
» kcmd(ref,'list',1)
```

A given command, like **I** seen before, can be implemented in a specific function, like “kgetanalog”. The same example seen before becomes

```
» kgetanalog(ref,15)
ans =
606
```

This function is implemented as following:

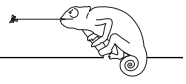
```
function r = kGetAnalog(ref,channel)
% KGETANALOG   Read the analog inputs

if nargin ~= 2
       disp('Usage:')
       disp('value = kGetAnalog(ref,channel)')
       disp('Returns a vector of values corresponding to a vector of channels.')
       disp('Returns -1 if the channel is not found.')
       disp('Use the reference obtained with kopen.')
       disp('Skye Legon, K-Team SA, 02/99')
       return
end

r = ones(size(channel));
for i = 1:length(channel)
       reply = kcmd(ref,sprintf('I,%d',round(channel(i))));
       [value,count,errmsg] = sscanf(reply,'i,%d');
       if isempty(errmsg)
              r(i) = value;
       else
              r(i) = -1;
       end
end
```

Other similar functions are in the package and cover all the protocol commands available and presented in Appendix A.

9 REFERENCES



[National98] National Instruments, LabVIEW manuals for the release 5, january 1998.

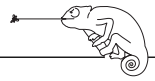
[Motorola98] Motorola, A Background Debugging Mode Driver Package, AN1230/D.

http://mcu.motsps.com/lit/app_notes/an1230.pdf

[K-Team99] K-Team, High Performance 68376 CPU board, 1999.

http://www.k-team.com/download/kameleon/documentation/Data-Kameleon376SBC.pdf

APPENDIX A COMMUNICATION PROTOCOL TO CONTROL THE BOARD



This communication protocol allows the complete control of the functionality of the Kameleon board trough a RS232 serial line. The connection configuration needed is presented in section 5.2. The set-up of the serial line of your host computer must correspond to the one set on the Kameleon board with the jumpers (normally running mode 5, see “Running modes” on page 6). The protocol is constituted by commands and responses, all in standard ASCII codes. A command goes from the host computer to the Kameleon board: it is constituted by a capital letter followed, if necessary, by numerical or literal parameters separated by a comma and terminated by a line feed. The response goes from the Kameleon board to the host computer: it is constituted by the same letter of the command but in lower case, followed, if necessary, by numerical or literal parameters separated by a comma and terminated by a line feed.

To better understand this protocol we propose to do a very simple test as following:

- Set the switch of the Kameleon board for the running mode number 5 (See figure 17).
- Set the connection configuration presented in section 5.2.
- Start on your host computer a terminal emulator with the serial line set to 38400 Baud, 8 bit data, 1 start bit, 2 stop bit, no parity.
- Type the capital letter **B** followed by a carriage return or a line feed.
- The board must respond with **b** followed by an indication of the version of software running on the board and terminated by a line feed.
- Type the capital letter **I,15** followed by a carriage return or a line feed.
- The board must respond with **i** followed by a number separated by a comma and terminated by a line feed. This number represent the power supply voltage in 20mV units.
- Try other commands:

List of Available Commands

(∏ indicates CR (carriage return) **or** LF (line feed). ¶ indicates CR **and** LF.)

B Read software version

Format of the command: B∏

Format of the response: b, version_of_BIOS, version_of_protocol¶

Effect: Give the version of the software present in the EPROM of the Kameleon board.

I Read A/D input

Format of the command: I, channel_number∏

Format of the response: i, analog_value¶

Effect: Read the 10 bit value corresponding to the channel_number analog input. For the channels between 0 and 14, the value 1024 corresponds to an analog value of 4,09 Volts, which means that the unit is 4mV. Channel 15 is reserved to the measurement of the power supply voltage. The unit of the returned value is 20mV.

L Change LED state

Format of the command: L, LED_number, action_number∏

Format of the response: l¶

Effect: Perform an action on one of the five LEDs of the Kameleon board. Possible actions are: 0: turn OFF, 1: turn ON, 2: change status. The LED number 0 is the nearest to the RS232 connector. LED number 4 is normally used by the ALIVE process (see “LEDs” on page 9).

T Send a message to an extension turret

Format of the command: T, turret_ID, command∏

Format of the response: t, response¶

Effect: Send a command and return the response of the intelligent extension turret placed on the K-Net and having a turret_ID. The list of turrets connected and their ID can be requested with the tool “net”. The command parameter takes the same format as a standard command, including an identification capital letter followed, if necessary, by numerical parameters separated by a comma and terminated by a line feed. The response takes the same format, starting with the same letter but in lower case, followed, if necessary, by numerical parameters separated by a comma and terminated by a line feed. The command and response format are specific for every module.

R Read a byte on the extension bus

Format of the command: R, relative_address∏

Format of the response: r, data¶

Effect: Read the data byte available at the relative_address (0...63) of the extension bus.

W Write a byte on the extension bus

Format of the command: W, data, relative_address∏

Format of the response: w¶

Effect: Write the data byte at the relative_address (0...63) of the extension bus.

APPENDIX B CONNECTORS

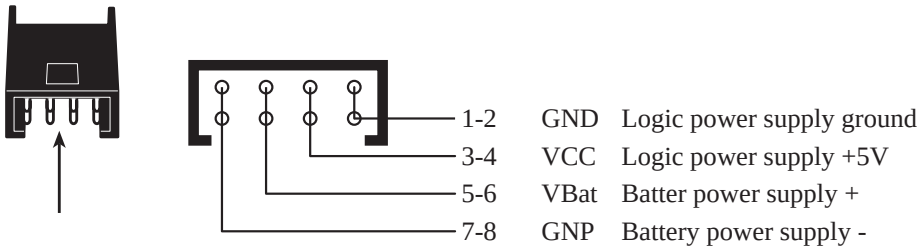


Figure 26: Power supply general connector pinout (see “Power supply and main fuse” on page 5).

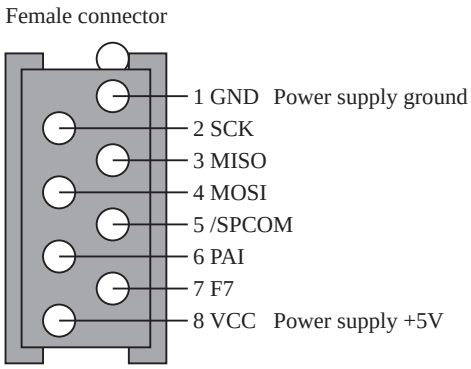


Figure 27: K-Net connector (see “The K-Net extension connector” on page 10).

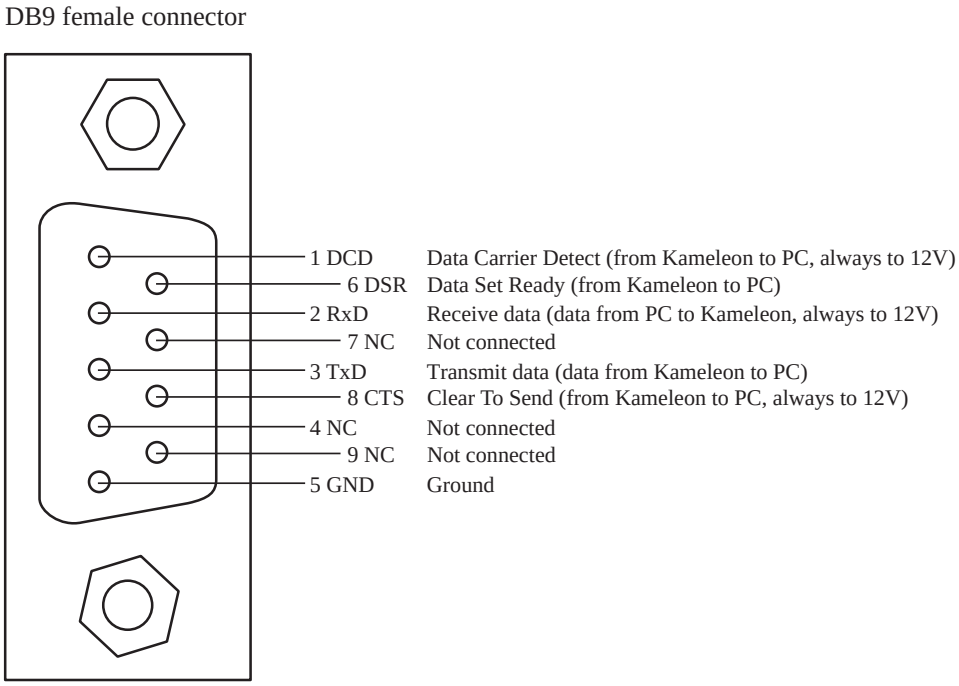


Figure 28: RS232 connector (DCE, 9 pins, see “The RS232 connector” on page 10).

APPENDIX C HOW TO DOWNLOAD CODE

To download user application code into RAM, please operate as following:

- Set your environment as illustrated in section 5.2. The jumpers must be set as showed in figure 29, to obtain the running mode 5 (for more details on running modes please refer to section 3.1.5).

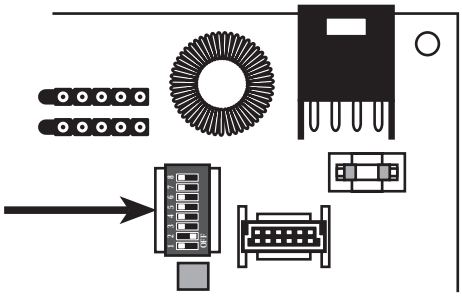


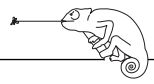
Figure 29: Settings of the jumpers for downloading code at 38400 baud.

- Power supply the Kameleon board.
- Start on your host computer a terminal emulator with the serial line set to 38400 Baud, 8 bit data, 1 start bit, 2 stop bit, no parity.
- Type **run sloader** followed by a carriage return or a line feed.
- Send the S format file containing your application.
- As soon as the application is loaded, the application is executed.

To download user application code into the FLASH, please operate as following:

- Set your environment as illustrated in section 5.2. The jumpers must be set as showed in figure 29, to obtain the running mode 5 (for more details on running modes please refer to section 3.1.5).
- Power supply the Kameleon board.
- Start on your host computer a terminal emulator with the serial line set to 38400 Baud, 8 bit data, 1 start bit, 2 stop bit, no parity.
- Type **flash E** followed by a carriage return or a line feed.
- Type **sfill** followed by a carriage return or a line feed.
- Send the S format file containing your application.
- As soon as the application is loaded, type **flash W**. This write your application in FLASH memory.

APPENDIX D RS232 CONFIGURATION



On PCs, a common terminal emulator is Hyper Terminal. Figure 30 shows the configuration panel set for a communication speed of 9600 baud on COM1.

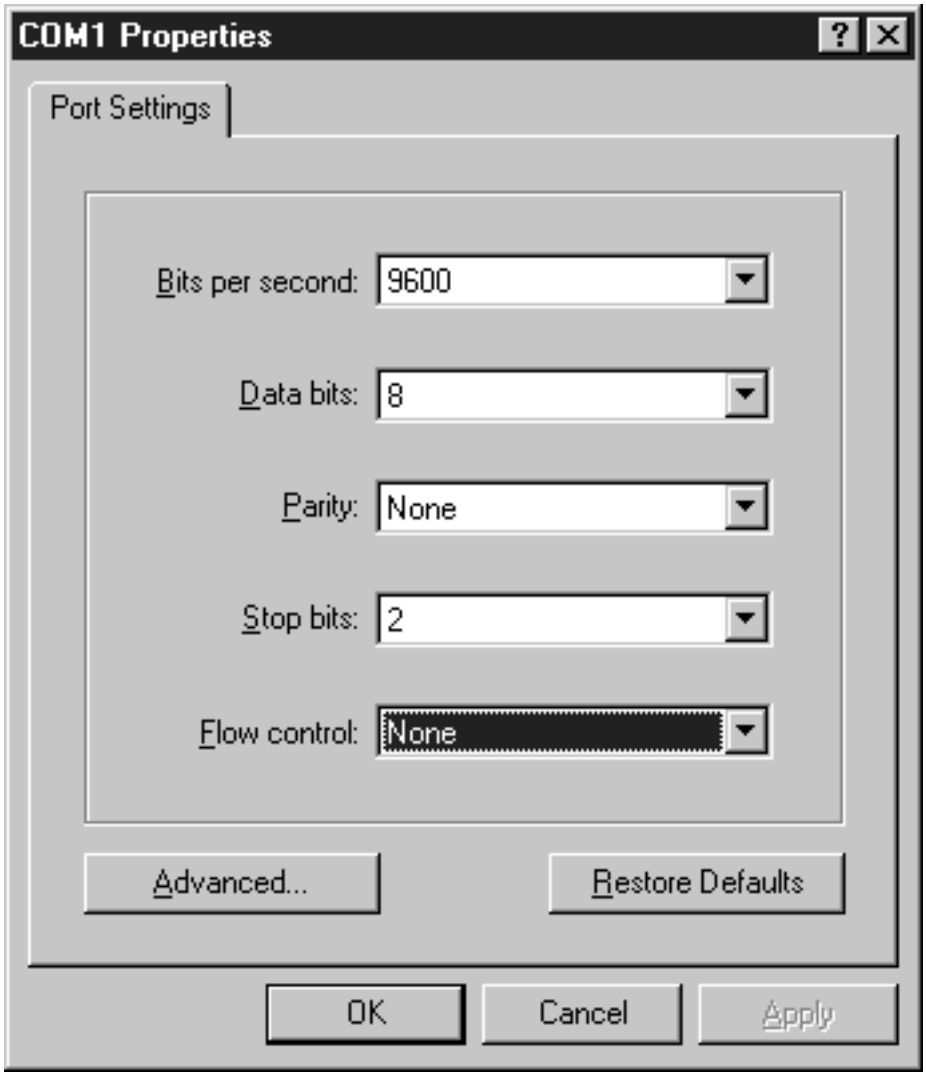


Figure 30: Hyper Terminal configuration panel.

On MAC you can use the software ZTerm. The main configuration panel is illustrated in figure 31. You have of course to choose the correct “Serial Port” (in the “modem preferences” menu) where the board is connected.

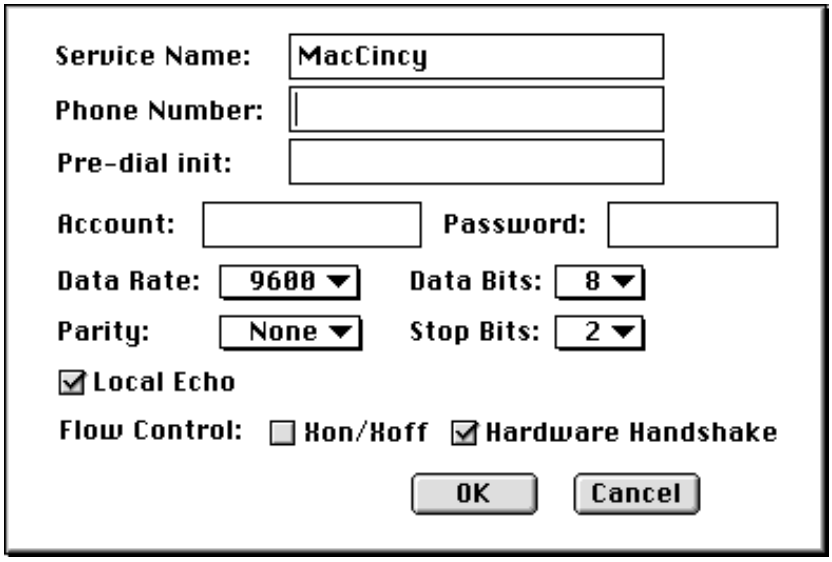


Figure 31: Microphone communications settings.

On LINUX you can use MINICOM, where the settings can be adjusted running “minicom -s” as root or by changing the settings with the CTRL-A O command. The correct settings are illustrated in figure 32 and figure 33.

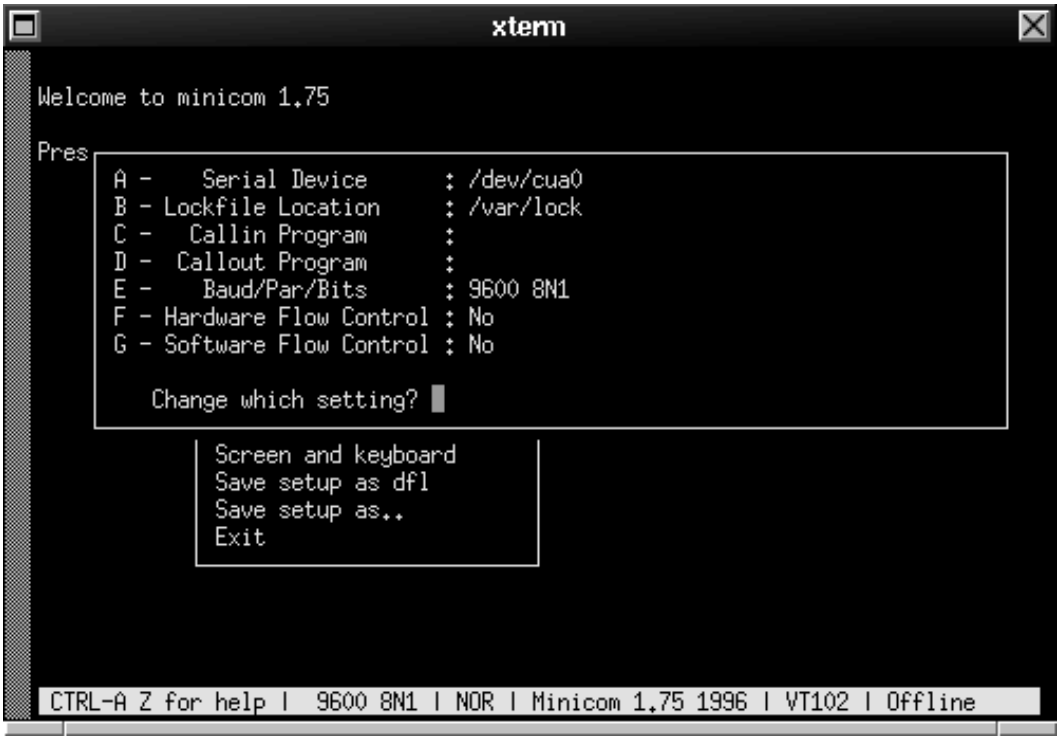


Figure 32: Serial port setting in MINICOM.

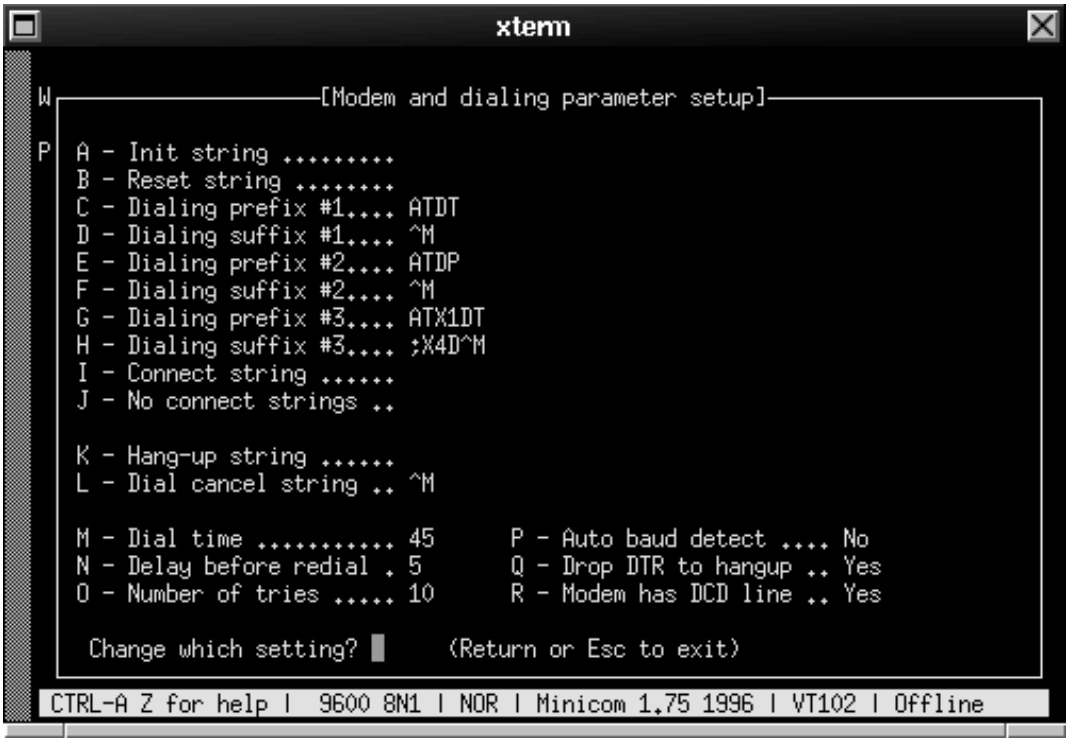


Figure 33: Modem settings in MINICOM.

On SUN, a common tool is “tip”, used on the /dev/ttya or /dev/ttyb ports. More details are given in the manual “man tip”.

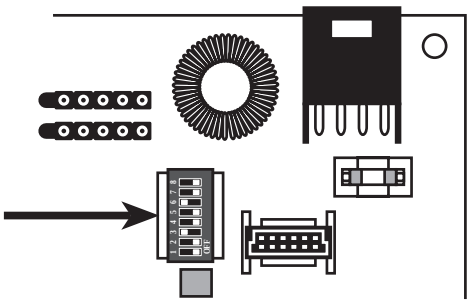
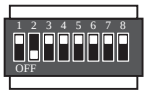
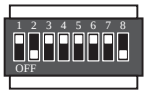


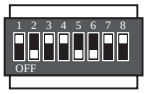
Figure 34: Position of the DIP-switch running mode selector.



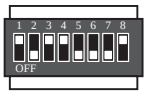
SerCom communication on RS232 at 38400, MUBUS interface powered



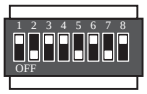
SerCom communication on RS232 at 38400, MUBUS interface not powered



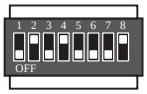
SerCom communication on RS232 at 38400, MMA master



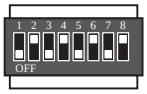
SerCom communication on RS232 at 38400, MMA slave 0



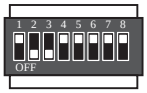
SerCom communication on RS232 at 38400, MMA slave 1



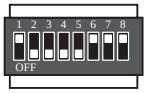
SerCom communication on MMA, MMA slave 0



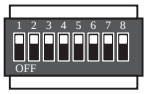
SerCom communication on MMA, MMA slave 1



User FLASH application, MUBUS powered



User FLASH application, MMA master



Reloading system mode. WARNING, this mode erase the system!

Figure 35: Examples of common running modes.

To have more details on how to select running modes, see “Running modes” on page 6.

The set-up of the jumpers can be changed at any time. **If the Kameleon board is running it is necessary to reset it to make the set-up effective.**